IMPERIAL INSTITUTE
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"To the solid ground
Of Nature trusts the mind that builds for aye"—Wordsworth

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A Hundred Years Ago

ON another page in this issue will be found the names of some of the most notable men of science, engineers and inventors who died in 1834 The list, although it is not an exhaustive one, is representative, and recalls the activities of some of those who lived in the first third of the nineteenth century, a period which was marked by a great increase in scientific studies, in the number of scientific and technical journals and in the list of scientific societies It was, moreover, a period which ushered in those revolutions in transport and communication which will always render the nineteenth century memorable

The year 1834 was perhaps not marked by any such epoch-making event as the inauguration of regular steam navigation by Fulton in 1807, the discovery of electro-magnetism by Oersted in 1819, or the opening of the Liverpool and Manchester Railway in 1830, but the immense activities of the time are reflected in the pages of many publications, in the records of Patent Offices, and in the proceedings of Parliament The world was just beginning to reap the harvest sown in the eighteenth century by such men as Franklin, Cavendish, Black, Lavoisier, Arkwright and Watt, and men's minds were filled with the possibilities of still richer rewards to be gained The achievements of our own days, it must be said, far surpass the visions of 1834, but there are many incidents of that time worth recalling, and during the present year we propose to record some of the happenings—scientific, industrial and social—of 1834 such as would have been noticed in the columns of NATURE had it been founded in that year instead of 1869

A picture of the world of science in 1834 presents many interesting details and includes many notable men In Great Britain, among the outstanding men of science were Brewster, Lyell, Herschel, Dalton, Whewell, Babbage, Faraday, Wheatstone, Forbes, Murchison and Graham, abroad, among the most distinguished were Ampère, Arago, Liebig, Oersted, Hansen, Gauss and Humboldt In 1834, Sir John Herschel, at the Cape, was engaged on his survey of the southern heavens, Faraday at the Royal Institution was investigating the action of the voltaic cell, Wheatstone at King's College was determining the velocity of electricity, Liebig at Giessen was making his laboratory the Mecca for young chemists, while Darwin in the *Beagle* was exploring the coasts of South America

A century ago scientific societies were multiplying apace and the British Association, then three years old, largely through the efforts of J D Forbes, in 1834 held its meeting at Edinburgh Sir Thomas Brisbane was the president a hundred years ago and among the distinguished visitors from abroad was Arago The notable scientific books of the year included Baden Powell's "History of Natural Philosophy", Prout's "Bridgewater Treatise" on chemistry, Arago's "Astronomie Populaire" and the first part of Becquerel's "Traité de l Electricité et du Magnetism". It was also in 1834 that the French railway engineer Clapeyron published in the journal of the École Polytechnique his memoir "Theorie mécanique de la chaleur", which was destined to lead Kelvin to search for a copy of Sadi Carnot's essay of ten years earlier

At the same time, in the world of practical engineering great advances were being made in many directions Improvements were being introduced in the manufacture and working of iron and steel, in the construction of machine tools and in the building of iron structures The Stephensons, Locke, Brunel, Rastrick and others were engaged on the plans for the London and Birmingham Railway and other lines, Hancock, Maceroni, Church and Scott Russell were attacking the problem of applying steam to road vehicles, a promising line of invention the success of which was prevented partly by the railways and partly by legislation, and shipbuilders and marine engineers were planning to build steam vessels capable of crossing the Atlantic under all conditions of weather. Mails and passengers were even then carried to Alexandria by steam, and steam vessels were found in all waters, but a voyage across the Atlantic was still done under sail, occupying sometimes six or eight weeks

The growing interest in all these matters is shown by the records of patents and by the establishment of journals appealing mainly to the engineer and mechanic One of the journals of a century ago which combined in its pages accounts of the work of men of science with descriptions of machines and engineering practice was the *Mechanics' Magazine, Museum Register, Journal and Gazette*, briefly known as the *Mechanics' Magazine*, published first in 1823 In the preface to the first volume its editors said that

> "the object proposed by this publication at its outset was one of entire novelty and no inconsiderable importance A numerous and valuable portion of the community, including all who are manually employed in our different trades and manufactures had begun for the first time, to feel the want of a periodical work, which at a price suited to their humble means, would diffuse among them a better acquaintance with the history and principles of the arts they practise, convey to them earlier information than they had hitherto been able to procure of new discoveries, inventions and improvements and attend generally to their peculiar interests as effected by passing events."

The successful way in which the journal fulfilled these objects led Dr. Birkbeck, at the opening of the London Mechanics Institution—now the Birkbeck College—to declare that the *Mechanics' Magazine* was "the most valuable gift which the hand of science had yet offered to the artizan"

The recognition by the editors of the *Mechanics' Magazine* of the interdependence of abstract science and mechanical progress was but a sign of the times Scientific thought was invading many departments of human endeavour, and the advancement of science was seen to be a matter of national importance. It was this that had led to the founding of the British Association The gibes and sallies with which the birth of the "Parliament of Science" was greeted have long been forgotten, but in recalling the events of that time we shall be reminded of the benefits which have come from the labours of some of its founders and stimulated in our attempts to further the welfare of mankind.

Organising British Farming

The Foundations of Agricultural Economics together with An Economic History of British Agriculture during and after the Great War By Dr J A Venn Second edition Pp xx+600+20 plates (Cambridge At the University Press, 1933) 25s net

AN old French proverb asserts that there are three ways in which a gentleman may lose his money without dishonour on wine, on horses and on agriculture The British farmer, whether gently born or not, has had much experience of the last of these methods, but he is perhaps inadequately consoled by the reflection that he has not lost honour For some five or six years now, large classes of farmers have either failed to make a profit or else have actually lost money, and there are great sections of the country where farmers are heavily in debt to the banks or the merchants, and will have some difficulty in getting out Happily the Government is fully alive to the situation, and the strenuous advocacy of the Minister of Agriculture has enabled schemes for the improvement of agriculture to be developed and pressed forward which ten years ago would have seemed quite impossible

The fundamental trouble is the marketing and distribution of the produce The scientific worker can hold himself blameless so far as the immediate difficulties are concerned, though of course he has actually caused trouble by opening up for cultivation regions which fifty years ago were waste and produced nothing However, it is widely recognised that this question of production would right itself if only the marketing and distribution were more effective

The Government schemes now being put into operation involve much organisation of the industry, both for production and marketing The essential feature is that the organisation is to be done by the industry itself, and not by the State The advantages claimed are that the consumer is assured a supply of fresh food of good quality at reasonable price, and has, moreover, the knowledge that more labour is being used on the land, and therefore more people remain self-supporting and are kept from the various public assistance funds, than on the old methods. The farmer, on the other hand, is assured of a market at a price which has some relation to the minimum wage forced on him by law. It is too early to see how the schemes will work out, but among countrymen there is a general tendency to give them a fair trial.

A new factor in the situation is that townspeople are to-day much more interested in British agriculture than ever before in our time, and they are prepared to give up cherished ideas in order that agriculture may have a chance of success This has put a new responsibility on the shoulders of the farmer and the agricultural expert a high standard of efficiency in agricultural production and distribution must be maintained, and the worker must be given a fair share of whatever prosperity comes to the countryside

Fortunately, at this critical stage in the history of British agriculture, Dr Venn has brought out a second edition of his well-known "Foundations of Agricultural Economics" The first edition appeared ten years ago, but this has been so completely revised and so greatly extended that it has become a new book In the meantime, a considerable amount of new material has become available in the form of various Government and other reports, and moreover Dr Venn has travelled widely and greatly enriched his agricultural experience The result is a book which we can unreservedly recommend as a great success

After a description of the various methods of land tenure, past and present, and of certain of the more serious proposals for expropriation, the author passes to a consideration of the relation between size of holding and farming efficiency Good summary tables are inserted showing the main facts very clearly Cereal production and sheep farming emerge as the special prerogative of the large farmer and pig keeping as that of the small-holder, but the main facts are shown in the following figures —

Size group (acres)	Farm capital per acre (£)	Manual workers per acre (number)	Gross output per acre (£)	Gross output per £100 manual labour (£)
20 50	11 4	5 6	10 1	187
50 100	10 8	4 2	7 4	188
150–300	9 3	2 8	5 9	212
Over 500	8 1	2 4	4 8	215

In this table lies the crux of the whole discussion about small-holdings Are we to aim at higher output per man with low capital charges, small number of workers and low output per acre, or shall we prefer higher output per acre with its accompanying higher capital charges, greater density of settlement but lower output per man? If we decide on fostering the system of lower output for the sake of the greater numbers of people settled on the land, who is to bear the burden of the difference between the £187 as the manual output from the small farm, and the £215 as manual output from the large farm ? At present the capital charges of the small farms are largely borne by the State the cost of this Dr Venn estimates at nearly one million pounds per annum The difference in return as compared with the large farm is borne by the small-holder and his family, and a hard life they often have in comparison with the worker employed on the large farm

So long as these arrangements can be maintained, of course the small-holder is likely to survive, for there are always men who prefer independence to paid employment. Dr Venn shows, however, that the attractiveness of the agricultural wage earner's position is steadily increasing, and never in his long history has he been so well off as to-day labour costs, which fifty years ago amounted to 20 per cent of the farm outgoings, amount to-day to 38 per cent , while expenditure on materials, livestock and implements, formerly more than 50 per cent, now is 36 per cent of the total Rent has fallen from 17 per cent to 13 per cent and rates on farmed land from 1 8 per cent of outgoings to nothing It is shown, too, that farm workers frequently become tenant farmers or occupying owners

Some interesting relationships are brought out between the yields of crops and the conditions of cultivation The yield of cereals in different countries varies inversely with the area grown The yield of potatoes, on the other hand, varies directly with the density of population This generalisation will be new to many agriculturists, but the diagram on p 124 is very convincing Dr Venn can find no evidence that this is a question of size of holdings he attributes it to the greater use of spade husbandry and the better supplies of fertilisers and manures in densely populated countries , but one may ask whether the climatic and other physical conditions that make for dense human populations are not also those that best suit the potato crop ?

Throughout the book there are many stimulating suggestions for the investigator in agricultural economics Why, for example, should there be a marked fall in wheat acreages every ninth year from 1877 onwards—masked only in 1922 but brought out again in 1931 ?

Some interesting chapters follow on the recording of the amount of agricultural production, one of the most difficult problems confronting the agricultural expert It is relatively easy in Great Britain to estimate the quantities of food imported, but exceedingly difficult to know how much is produced here Farmers rarely weigh their produce estimates are by eye. Dr. Venn gives reasons for thinking the official estimates are too low, and the disparity between the recent estimates of pigs available for bacon production in the near future, and the number actually offered by farmers, is still fresh in the public mind by reason of the revision it entailed in the quota permitted to Denmark He prefers the estimates of the *Times*, but agrees that the method proposed (and in point of fact now being investigated) of weighing the produce of certain selected areas is the soundest and will give the best results if it can be put into operation

The book concludes with an interesting account of the changes in British agriculture during the War and afterwards, and it gives a good summary of the measures now proposed for its improvement

E J RUSSELL

Social Life in Old Israel

Ancient Hebrew Social Life and Custom as indicated in Law, Narrative and Metaphor (The Schweich Lectures of the British Academy, 1931) By R H Kennett (Published for the British Academy) Pp vi+114 (London Oxford University Press, 1933) 6*s* net

EVERY period has its special interests and similarly the sciences their special fashions During the last century, interest in the Old Testament was predominantly theological and historical, from the point of view of Christian theology and the history of the Christian religion , we, however, in our times have learnt to look at parts of the Old Testament from a social aspect For us, life has changed and its centre has been transferred to the economic and social sphere Prof Kennett's book is pointing to this direction, and we have good reason to tender our grateful admiration to this eminent scholar and our thanks to Prof Burkitt for having published the manuscript after Prof Kennett's death The author has limited his skilful investigation to the Scriptures, and it is amazing what a brilliant picture he has given us from the somewhat scanty indications scattered over the whole Old Testament In this small study he again shows his supreme intimate knowledge of the Scriptures and his great gift of vivid description

The Hebrew people were a nation of peasants ; agriculture was the basis of the social life. The customs and habits were first and foremost rural; therefore most of the book deals with the life of the countryside. We can almost see the Hebrews in their houses, at their meals and at work. We follow them from birth to death, watch them in their rejoicing and mourning It is obvious that the social classification should find its expression in the way of housing, clothing and food The poorer class houses, for example, were built of unbaked bricks, or unhewn stones cemented with clay, whereas the houses of the rich and wealthy were of hewn stone and not seldom had painted or inlaid walls Parables and metaphors teach us that the poor shared their one-roomed house with the cattle As throughout the Orient, the flat roof played an important rôle and also served sometimes as a foundation for summerhouses for the wealthy people. Houses with upper floors contained separate bedrooms and often accommodation for guests Royal palaces, of course, were distinguished by a richer architecture and ornaments and had store-rooms, even wine-cellars

Wine leads us on to the water supply, perhaps more precious, and certainly most important, for the Orient What we read here of the Hebrews of old will be confirmed by every traveller in the Near East Wells are rare and a privilege of the rich Usually, we find a cistern hewn in the rock. We know that Jerusalem was supplied with water from outside by a subterranean conduit (Siloah Tunnel) which was very important in times of war and siege

We read of beds, tables, pottery, lamps and other household utensils, of how the people cleaned and ground the corn. The nomads lived mostly on milk, the non-nomadic majority on bread baked into loaves both leavened and unleavened Were the corn short the poor man ate "a portion of green herbs"—even roots and wild vegetables served as food Strongly flavoured vegetables were the rule, whereas cucumbers, for example, were considered a luxury. There was also animal food, mainly mutton and goat. Locusts, a frequent plague in Palestine, were a common food Grapes took the first place amongst various kinds of fruit, figs and pomegranates were frequent Banquets were held on special occasions, such as the circumcision of newly-born sons, a wedding, etc., accompanied in early times by sacrifices It is amusing to hear that the portion served to each guest corresponded to the esteem in which he was held and to the honour the host wished to pay him.

With regard to clothing, there was a great variety amongst the rich. Girdles were the most common 'garments', they were of various shapes, from the belt to the apron, and of course were used to gather in the coat. A tunic was generally worn next to the skin, the upper classes wore a long robe as an outer garment The material consisted of wool, flax and linen, spinning and weaving were practised at home. The various colours mentioned indicate that dyeing was known Sandals were worn covering the front part of the foot only. A covered head was a privilege of the nobles and the dignitaries Women used various sorts of cosmetics Prof. Kennett states that the status of women was not equal to that of men, but we may say that Jewish women were much more highly respected than any other Asiatic women, eminent women are known and the female characters of the Old Testament show that the Hebrews knew and appreciated the virtues of a good woman. Usually the Queen Mother had a considerable influence.

Music and dancing were a part of religious ceremonies as well as a natural expression of human joy, and there is no indication of their origin in "nature-worship superstition", as Prof Kennett is inclined to think.

As to the occupations of men, first of all was the warrior, next came the owner of flocks and herds The majority, however, earned a livelihood by agriculture, but their social position was considered as somehow inferior. The plough and yoke were the chief implements. The land was divided into portions, and accumulation in one hand to the disadvantage of others was forbidden by law The social justice of old Israel, never surpassed, is to be seen in the laws concerning the land and its distribution, for example, the command to leave the corner of the field to the poor in harvest time as well as to divide the land anew in every seventh year, the year of fallow coinciding with the release of the slaves Land, vineyards and gardens, cultivated by the peasantry, supplied the necessary food for the population, and workers in wood and metal, mechanics, etc., provided the other necessities of life Luxury trades (goldsmiths, jewellers, perfumers) were also represented in the towns A chapter on the administration of justice and law and the verification of a 'trial by ordeal' amongst an Arab tribe of the present day conclude this interesting book.

This is not the place to discuss and appreciate the scholarly value of this work for biblical research, but it may be recommended to those interested in the life described in the Old Testament.

The Problem of Population

Roman Catholic Methods of Birth Control By Dr Marie Carmichael Stopes Pp xv+235 (London. Peter Davies, Ltd, 1933) 6s net

IN this book Dr Marie Stopes is mainly occupied with her quarrel with the Roman Catholic Church, the authorities of which have actively opposed her campaign on behalf of birth-control. But Dr Stopes succeeds in showing that that Church is not so obscurantist as some of the religious bodies more nearly allied to it. For, as she points out, the Church does sanction certain methods of contraception, and her complaint is that these methods are obsolete, since they are ineffective and physiologically undesirable

It is not our purpose to discuss the relative merits of more modern methods, and in particular of the method which Dr Stopes advocates, though in passing we may remark that a great stride forward was made when it was discovered that one of the most effective contraceptives was ordinary soap and water Rather we would wish to point out that whatever method may ultimately be adopted, some form of control is absolutely necessary unless the three great calamities, war, pestilence and famine, described by Tertullian as the divinely appointed agents in regulating population, are again to recur

The biologist feels doomed to play the rôle of Cassandra. he sees catastrophes approaching but is fated for the most part to prophesy to deaf ears It is gradually becoming clear that populations of mammals, birds, and fish at least, and probably of all other animals as well, undergo periodic enormous increases, followed by devastation by multiplying enemies and disease until they are again reduced to their natural dimensions One of the best-known instances of this is the recurring plagues of lemmings, which, urged on by a wild impulse of migration which always supervenes on overcrowding, emerge from the forests which are their natural home, and devastate the cultivated lands These hordes of rats are harassed on their course by crowds of their natural enemies such as hawks and weasels, and they are decimated by disease The last survivors plunge into the Atlantic and swim towards the west vainly seeking for the lost Atlantis that has drifted away from them More familiar phenomena are, however, due to the same cause A succession of good 'fishing years' is followed by others when the yield is poor It has been shown that 'poor years' do not result from a lesser production of spawn What determines a good or a poor year is the number of eggs which survive In a word, it is not the birth-rate but the survival rate which determines the size of the adult population The survival rate in turn is due to the food in the form of diatoms, etc, available for the young when the yolk-sac is exhausted A lucky year in which plenty of diatoms were available has produced a population of herrings which have supplied the fishermen with abundance for sixteen years! When we recollect that all the efforts of modern philanthropy are directed to increasing the human survival rate, the effect of increasing the herring survival rate gives us serious matter for thought

In the Middle Ages, and until as lately as two hundred years ago, the growth of population in England was kept in check by very similar agencies as those which now control the populations of herrings Then, out of every five children born in London, three died before they were five years old Indeed, the sudden increase in population which began in the latter part of the eighteenth century, and which has usually been attributed to the so-called 'Industrial Revolution', has been shown by Miss Buer to have been largely due to vaccination and better drainage.

England is now the most thickly populated country in the world with 486 people to the square mile, our better classes are restricting their families, but the least skilled go on recklessly breeding, and we frequently read of railway workers with eleven children indignantly demanding houses to contain them, of men on the dole with thirty shillings a week producing nine children Foolish and sentimental optimists point to our Dominions, large red patches on the maps, as homes for this increasing population They forget that more than a half of Canada is an icy tundra, and three-quarters of Australia a burning desert It is true that the backbone of the population of both these countries is made up of the descendants of hardy British emigrants; but these emigrants settled long before the days of doles and social services

In the last resort it would appear that wars are always due to racial pressure. Politicians may be foolish and arrogant, but they dare not risk wars unless supported by the people behind them. A feeling of over-population and being 'hemmed in' has obsessed Germany for a long time: the reviewer heard it forcibly expressed by a German friend in 1892 Since the War the over-population of Germany has been proclaimed by Herr Hitler. Japan is about the size of the British islands, but only about one tenth of its area is arable. The population is 61,000,000, and is increasing by one million a year. It is scarcely necessary to look further for causes of the recent Chino-Japanese war Because catastrophes such as those which occur in the animal kingdom do not take place every twenty or thirty years amongst human populations, the short-sighted ridicule the idea that they ever will occur, but the most superficial study of history proves that the optimists are wrong It seems to us that the most stupendous task that lies before our rulers in England is the regulation of population; to see that no one is permitted to bring into the world children whom he cannot support, and that we should breed from the thrifty and competent and not from the idle and shriftless

E W M

Insects and Man

(1) *Medical Entomology* By Prof Robert Matheson. Pp xiii+489 (London. Baillière, Tindall and Cox, 1932) 29*s*

(2) *Medical Entomology. a Survey of Insects and Allied Forms which affect the Health of Man and Animals.* By Dr. William A Riley and Dr Oskar A Johannsen. (McGraw-Hill Publications in the Zoological Sciences) Pp xi+476. (New York McGraw-Hill Book Co, Inc, London· McGraw-Hill Publishing Co, Ltd, 1932) 27*s* net

WHILE medical entomology is mainly concerned with the parts played by insects and ticks in the transmission, causation and spread of disease, its limits have to go farther afield It needs to embrace all kinds of stinging creatures, species with vesicating and urticating properties, and other forms which function solely as intermediary hosts of human parasites. The growing subject of myiasis requires full exposition and, to-day, the utilisation of dipterous larvæ as healing agents in cases of chronic osteomyelitis can scarcely be passed over. A modern textbook will also need to discuss the rôle of Oscinid flies in connexion with conjunctivitis. the little-known diseases of turalæmia and onchocerciasis, together with the growing importance of mites (*Trombicula*, etc), and of sand-flies in relation to obscure tropical and subtropical diseases The literature in these diverse fields grows with such rapidity that *few*, excepting professed medical entomologists, can keep properly abreast of current developments This task is rendered the more difficult owing to the range of periodicals, monographs and government publications that have to be consulted.

(1) Dr Matheson's book is to be commended as a handy and up-to-date manual He has explored his subject with thoroughness and provided a clear and orderly presentation of facts and theories. He has, in fact, written a thoroughly sound and comprehensive introductory text which should appeal to the entomologist, medical man and student alike The bibliographies at the ends of the chapters greatly enhance its value, and its two hundred or so illustrations are clear and well chosen, none of these latter is a familiar 'old stager' The book is singularly free from omissions and misprints, but we think that its utility may be restricted owing to its somewhat high price

(2) Messrs Riley and Johannsen explain in the preface of their book that it is a revision of their earlier manual entitled a "Handbook of Medical Entomology", published in 1915 It differs from its predecessor in that the subject matter has been rearranged while the text has been extended and much new knowledge incorporated In a compass of little more than 450 pages, practically every known disease or affection connected directly or indirectly with insects or other arthropods is taken into account The essential facts respecting the etiology of such diseases are clearly presented while preventive and remedial measures are adequately discussed.

On the entomological side, very full taxonomic keys serve to identify the different species of insects, etc, that are involved, while their habits and measures of control are also dealt with On the other hand, the book is much less informative as regards the structure and physiology of the essential parts and organs directly concerned with disease transmission by insects The reader, for example, will have to go elsewhere for information on the mouth-parts of a mosquito, *Stomoxys* and *Glossina*. Little is said about the complex feeding apparatus of the house-fly and its allies, and a proper understanding of this subject is necessary in order to appreciate the rôle such insects play in relation to disease organisms Apart from omissions of this kind, the book can be recommended as a sound and up-to-date exposition of its subject

The works of a large number of authorities have been drawn upon in its preparation It is, however, disappointing to find many names quoted are omitted from the list of references and that their spelling is not always correct.

A. D. I.

Short Reviews

Die Tierwelt der Nord- und Ostsee Begrundet von G Grimpe und E Wagler Herausgegeben von G Grimpe Lief 23 Teil 1.b *Biologische Geschichte der Nord- und Ostsee*, von Sven Ekman, Teil 2 c_2 *Tintinnidæ* (*Nachtrage*), von E Jorgensen und A Kahl, Teil 2 c_3 · *Ciliata libera et ectocommensalia*, von A Kahl, Teil 10 g_3 · *Mysidacea*, von C Zimmer; Teil 10 g_4 *Cumacea*, von C Zimmer. Pp 40+27–146+29–120 (Leipzig Akademische Verlagsgesellschaft m b H, 1933) 24 gold marks

The twenty-third issue of "Die Tierwelt der Nord- und Ostsee" is full of interesting matter Dr Ekman's survey of the biological history is excellent, dealing chiefly with the late and post-Glacial history of the North Sea fauna and of the Baltic fauna and of present-day relicts Dr Zimmer's accounts of the *Mysidacea* and *Cumacea* cover a large number of species with details of their biology, anatomy and systematics, much of the special biology being based on his own investigations

The largest part is occupied by Dr Kahl's monograph on the *Ciliata* (free and ectocommensal) This includes not only those forms which are known from the area, but, because of the probable cosmopolitan distribution of many species, it also embraces those from the seas and brackish waters of the world 700 species are here described with notes on the general characters, biology and habitat Original instructions for collecting and a short paragraph on the culture of these interesting Infusoria are added Out of 117 pages, 100 are taken up with the systematic account, which consists of keys to the orders, sub-orders, families and genera and, under each genus, a list of species with short diagnoses. Full-page figures containing many drawings, as well as text figures, illustrate these To describe so many forms in so small a space is an achievement which must have involved an enormous amount of work, only possible from one who knows his subject very thoroughly In Dr Kahl we have such a specialist and he is to be congratulated on the result, which will be helpful to all workers

Colon Classification By S R Ranganathan Part 1 *Rules of Classification*, Part 2 · *Schedules of Classification*, Part 3 *Index to the Schedules* (Madras Library Association Publication Series, 3) Pp xiv+128+136+106 (Madras Madras Library Association, London · Edward Goldston, Ltd, 1933) 15*s* net

The interesting library classification code set forth in this book by the Librarian of the University of Madras differs from others in that instead of showing a class subdivision for every topic, the schedules contain standard divisions arranged into groups according to function or characteristic, and the class-mark of any topic is obtained from a combination of the appropriate divisions of the various groups arranged in a specified order, the connecting links between the different groups being a set of special devices of which the most important is the colon from which the system derives its name It is rightly claimed that the schedule thus produced, while securing as great a degree of minuteness for the classification, occupies a great deal less space in print, but it has the disadvantage that the class allotment of every book necessitates reference to several sections before its correct place is found.

The classification, though dictated to a certain extent by the needs of the system, has been well done, and the scheme is both elastic and comprehensive, while at the same time providing for sensible variations to meet local circumstances The schedule for Indian literature has been very fully worked out The class-mark for NATURE under the scheme would be Am 561 M 68, and that for the book itself regarded as the classification code of the University of Madras Library, 251 33 · 44111q N33 A G

A Textbook of Biochemistry · for Students of Medicine and Science By Prof A T. Cameron. (Churchill's Empire Series) Fourth edition Pp. xi+556+2 plates (London. J. and A Churchill, 1933) 15*s*

This is the fourth edition of a work which is based on lectures given to students of medicine It is divided into six sections of which the first is introductory and physical, dealing with the conceptions of catalysis and hydrogen ion concentration Section 2 describes the constituents of the food-stuffs, sugars, fats, proteins, etc Section 3 treats with the chemistry of digestion, the circulation and the excreta, Section 4 with all that is comprised under the heading "Intermediate Metabolism". Section 5 handles quantitative metabolism, and the final section introduces the student to immunology and pharmacology To do all this within the compass of 500 pages is a feat; at the same time one cannot help reflecting how much the medical student is expected to master, especially when some of the complex formulæ are examined In this edition such subjects as the endocrine principles, the vitamins and the sterols have received increased attention as the knowledge of them has progressed The author has wisely incorporated recent work even at the risk of seeing some of it retracted; in this connexion he might well have made reference to that of Hilditch on the constitution of the fats.

As a minor correction we might note that strophanthin is no longer regarded as containing rhamnose and mannose, but consists of glucose and a unique sugar, cymarose. The book merits continued success.

Plant Distribution in the Aberystwyth District: including Plynlimon and Cader Idris. By Prof. Lily Newton. Pp. 50+8 plates. (Aberystwyth: The *Cambrian News*, n.d.) n.p.

THE scope of this book is to give a readable ecological account of a district which, as Prof. Salter rightly remarks in his preface, has been much neglected by botanists. Accounts of the physical features and geology of the district, and a brief section devoted to the ecological study of plant distribution, precede descriptions of the various types of maritime, lowland and upland vegetation of the area bounded by Aberayron and Tregaron on the south and Plynlimon and the Barmouth estuary and Cader Idris on the east and north. Descriptions of the submerged forests of Cardigan Bay and of the old lead-mining areas and their ecological significance are included and a comparison given of the two mountains, of which Cader Idris is the more varied and floristically richer.

Quantitative data as to plant frequencies and soil and light conditions are excluded from the treatment of the plant associations, and both English and Latin names are given for the species cited. Too brief a section dealing with factors influencing distribution emphasises the relation between altitude and plant distribution, but scarcely does justice to the rôle of soil factors. The book should be useful as a general ecological survey of the district and as a basis for more detailed investigation of its constituent plant associations.

The Cultivated Conifers in North America: comprising the Pine Family and the Taxads: Successor to The Cultivated Evergreens. By L. H. Bailey. Pp. ix+404+48 plates. (New York: The Macmillan Co., 1933.) 37s. 6d. net.

ALTHOUGH this book deals very largely with the conifers that can be grown out of doors in North America, the information it contains will be found to be useful to people in other countries also. Moreover, the range of conditions existing in North America is such that the majority of conifers from other regions thrive in one or another part of the continent; therefore comparatively few kinds are omitted.

The work is divided into two parts; the first is devoted to systematic descriptions of the genera and species hardy in North America, and the second to the cultivation of conifers for decorative purposes. A very useful feature of the first part will be found in the very good keys to species that accompany the descriptions of the larger genera. The second part of the book deals with cultivation, propagation, the selection of kinds for different positions, pests and diseases. Amongst name alterations, the name of the Douglas fir has been changed back to *Pseudotsuga Douglasii* from *P. taxifolia* without explanation. If such a change were necessary, a reason should have been given. Presumably *P. taxifolia* is regarded as a homonym.

Elementary Statistical Methods. By Dr. E. C. Rhodes. (London School of Economics and Political Science: Studies in Statistics and Scientific Method, No. 1.) Pp. v+243. (London: George Routledge and Sons, Ltd., 1933.) 7s. 6d. net.

IF this first volume of a new series of studies gives a true indication, the series is designed to introduce statistics to a public for which no language can be too elementary, no remark too obvious, no emphasis too crude. The attempt is significant, for stability of democratic government may well depend on the possibility of such an introduction, and when the experiment is made in the popular press, the journalist will be fortunate in having an authoritative model. Dr. Rhodes describes excellently the precautions with which the raw material of a statistical inquiry should be compiled, the nature of simple and weighted averages, the meanings of median and quartile and of deviation and dispersion, the use of graphs, and the analysis of time series by means of a moving average. There is a wealth of numerical and graphical illustration, but the index does not conform to any reasonable standard. E. H. N.

Broadcasting. By Hilda Matheson. (The Home University Library of Modern Knowledge, No. 168.) Pp. 256. (London: Thornton Butterworth, Ltd., 1933.) 2s. 6d. net.

THIS book is written by an author fully conversant with the subject. That radio communication is not unmixed good is generally admitted, and that its possibilities have as yet only partially materialised is patent to all who have watched its development. Anything that tends to bring about *rapprochement* between the nations is welcome. The suggestion offered, that radio in the home may increase the sum of laziness, must be noted, but this may be more than balanced by the broadening outlook of rural communities. Finally, it may be quoted, that "Broadcasting will only mechanise men, if it becomes the tool of a mechanistic State". P. L. M.

100,000 Whys: a Trip around the Room. By M. Ilin. Translated by Beatrice Kinkead. Pp. 138. (London: George Routledge and Sons, Ltd., 1933.) 3s. 6d. net.

THOSE best know how little they know, who are credited with knowing everything; and it may be that M. Ilin's small guide to general knowledge will serve in lessening to a slight degree the load of ignorance which so many carry. "Knowledge comes, but Wisdom lingers", so that even when our learning is the greater, by reason of the assimilated contents of this book, our wisdom may be not one whit increased. Both text and illustrations are likely to appeal most to the immature section of the general public to whom M. Ilin offers his book. The translation merits full praise.

Planetary Photography*

By DR. V. M. SLIPHER

THE Lowell Observatory was founded in 1894, by the late Percival Lowell, who maintained and directed it during his lifetime and endowed it by his will, that it might permanently continue astronomical research and in particular that of the planets. For nearly four decades now, it has been occupied with planetary investigations. It is situated at Flagstaff, Arizona, because, of the numerous places he had tested, it was here that Lowell found the conditions best for planetary studies. The major instruments of the Observatory are: (1) 24-inch aperture Clark refractor of 32 feet focus, (2) 42-inch Clark reflecting telescope, (3) a new 13-inch photographic telescope, (4) 15-inch Petitdidier reflector, and in addition several smaller instruments, together with a number of spectrographs, special cameras for photographing the planets, radiometric apparatus for use with the 42-inch reflector, for measuring the heat of the planets, and such laboratory equipment as is needed in the work carried on.

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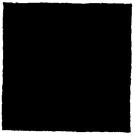

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FIG. 1.—Photographs of Mars showing the shrinking of the polar cap and the growth of dark areas.

During the first decade, the work at the Observatory was mainly visual observations of the planets, then it was extended to include their spectrographic study, and during the second decade direct photography of the planets was added and has been continued since, giving a permanent record of them to the present time. During the past decade, their heat measurement has also been made a regular part of the observational programme. In short, whenever it has been possible to apply new means, they have been made use of in order that the planets be studied from every possible point of view.

During the early years of the Observatory, Lowell was able to observe Mercury and to confirm Schiaparelli's conclusion that the planet constantly keeps its same face to the sun, as our moon does to the earth. Thus its small mass and the intense heating by the sun long since dissipated its atmosphere. Venus proved more difficult, and with very faint surface markings, its length of day was left somewhat uncertain, while from all considerations it appeared that this planet also keeps the same face constantly toward the sun, for even the spectrograph showed no evidence of a day shorter than a few weeks. Spectral studies of Venus have failed to give any evidence of an earth-like atmosphere, no bands of oxygen or water being found, although it might have been expected that Venus would be the planet most like the earth.

From this non-committal and veiled planet we pass to the best observed of all, Mars, which has long attracted wide interest. Martian seasonal change shows itself clearly in the polar caps, which alternately increase and decrease, and in the blue-green markings which darken in the growing season and pale again as winter approaches, the great ochreish expanses, changing little from winter to summer, except as influenced by light spots and clouds. The shrinking of the polar cap with summer's coming is to be seen in Fig. 1, where are shown five photographs of the same face of the planet showing particularly the upper hemisphere, but made at Martian seasonal dates. With the contraction of the cap the shaded areas darken and enlarge, as may readily be seen in the photographs.

Dark rifts appear in the melting caps, always at precisely the same time and the same places each Martian year, which clearly prove the caps to be deposits on the planet's surface. Irregularities of the surface must cause this patchy melting of the caps to be repeated always with most punctual harmony to the Martian calendar. Such features of the melting caps are to be seen in Fig. 1. The melting cap is bordered by a dark collar, and is more disposed to be regular in outline than the forming cap, which is irregular in outline and indefinite, and to begin with is erratic storm clouds only. An autumn cap appears at the opposite side of the planet to the polar cap

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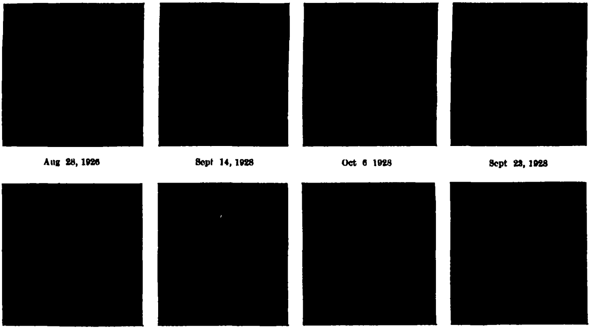
* From a discourse entitled "Planet Studies at the Lowell Observatory", delivered at the Royal Institution on Friday, May 19.

The behaviour of the caps means that Mars has an atmosphere, for that is the only vehicle which does such transportation of substance Occasionally, when Mars is so placed that we look a little into its night sky, we see on it a bright streak of light due to a cloud high in its atmosphere, catching the sunlight, while the surface is dark beneath it Such allow us to measure their height above the Martian surface, and a fine one in 1903 was fully 15 miles high, whereas clouds are rarely more than 5 miles above the earth Hence Mars must have quite a considerable atmosphere, and the spectrograph at Flagstaff showed it to contain water and oxygen, but no strange substances. Thus it closely resembles that of the earth, but is less dense, because the Martian surface gravity is only three-eighths of ours There is, therefore, good proof that the polar caps of Mars are snow. Long ago someone suggested they might be frozen carbonic acid gas, but Faraday himself showed experimentally the conditions of pressure and temperature required to solidify this gas; conditions which we are sure cannot prevail on Mars

Lowell, some years ago, deduced the temperature of Mars from a full evaluation of the factors involved, such as albedo, the behaviour of the caps, etc, and arrived at a value of 48° F. This has recently been confirmed by the radiometric measurements made at Lowell Observatory by Coblentz and Lampland.

While there is room for difference of opinion as to the interpretation of the canals of Mars, their existence as true markings on the planet has been clearly established, for they have been photographed and have been seen by nearly all skilled observers who have observed the planet carefully with powerful instruments The Lick astronomers Schaeberle, Campbell and Hussey of the early observers, and Trumpler more recently, all drew the canals Because changes take place in the planet's features in quite short time intervals sometimes, observers may seem to disagree and yet both be right.



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Sept 22, 1928 Nov 30, 1928 Oct 6, 1928 Oct 7, 1928

FIG 2 Photographs of Jupiter

Lowell regarded the canals as strips of vegetation along artificially produced water courses, for they, like the larger blue-green areas, darken when the time comes for seasonal growth in vegetation, and this led to the belief that vegetable life, and hence also probably animal life of some degree of intelligence, exist on Mars

Jupiter has received much study at the Lowell Observatory What we see on Jupiter are mostly atmospheric features, apparently nothing of a solid surface appearing Usually so much detail is present that the visual observer, owing to the planet's rapid rotation, has difficulty in recording properly in drawings and notes all he is able to see under good observing conditions. In these circumstances the aid of photography has been very important, and a photographic record of the planet, as complete as possible, has been kept at Flagstaff since 1905. Fig. 2 indicates the nature of the Jupiter markings and gives some idea of their rapid and sometimes extensive changes, which give some hint of the very great activity present on the planet

Spectrum analysis of the light of Jupiter has revealed a great number of dark bands in the red and infra-red, due to the selective absorption of its atmosphere Most of these are yet unidentified, but ammonia is present, and possibly also methane gas. The most remarkable quality of the planet's atmosphere is its rapidly increasing absorption into the longest wave-lengths, which must affect the radiation in a decided manner

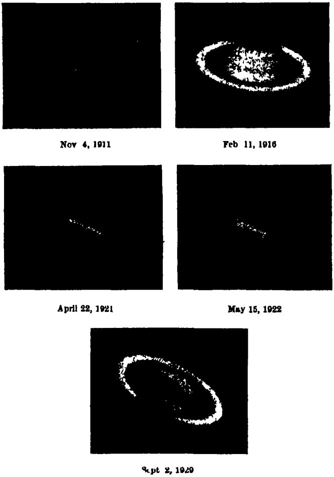
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FIG 3 Photographs of Saturn

Saturn has been regularly observed at Flagstaff, visually, photographically, and spectrographically Lowell studied theoretically the planet's law of mass distribution, the polar flattening and relation of satellites to divisions in the ring system, leading to new results Photographs of the planet and rings in light of different colours show some surprising changes, sometimes from year to year. It was found in 1921, when the earth and sun were very near the plane of Saturn's rings, that, contrary to previous belief, the rings could always be seen, and that the rings caused two dark lines across Saturn's ball, one the shadow of the rings and the other the rings themselves as seen dark against Saturn (Fig 3).

Spectrum analysis of Saturn's light shows much the same absorption bands as were found for Jupiter (except that those of ammonia are weaker in Saturn), so their atmospheres are much alike The rings show no atmosphere, but are meteoric The fact that the cloud belts of Saturn are so much weaker than those of Jupiter is doubtless due to the former having a very great seasonal disturbance owing to its highly tipped axis This factor is practically absent from Jupiter, and so allows its clouds to form and continue strongly belted parallel to the equator, whereas for Saturn the seasonal disturbance tends to destroy such belts

While Uranus and Neptune are each more than sixty times the volume of the earth, their great distances, nineteen and thirty times our distance from the sun, give them only tiny discs even in the largest telescopes, and markings on them are very difficult of observation Hence to get the rotation of Uranus the spectrograph was employed, it showed the planet's day to be 10 7 hours, and the rotation to be in the direction in which the satellites revolve

The spectrum analysis of these two planets has also taught us much as to their atmospheres They bear resemblance to those of Jupiter and Saturn, but show much more intense and numerous absorption bands, the strongest of which are present in the two latter planets This atmospheric band system is much more intense in Neptune than in Uranus, in short, the bands increase from Jupiter to Uranus and again from the latter to Neptune, somewhat with the distance of the planet from the sun

Fig 4 shows the spectra of these four planets compared with that of the moon, and gives a good idea of the manner in which the absorption bands increase from Jupiter to Neptune It is of interest to note that the ammonia band clearly evident in Jupiter, a little way to the left of C, is weak in Saturn, Uranus and also in Neptune

This study of the planets at the Lowell Observatory, in addition to many results not given here relative to the several planets, has much emphasised the differences of the two main groups of planets · Earth, Venus, Mercury and Mars, and the giant group—Jupiter, Saturn, Uranus and Neptune The first group are comparable with the earth in size, in density, in energy they receive from the sun and in atmospheres, so far as they show any at all The other group are much larger bodies, but of much lower densities, and have a very different type of atmosphere, while the solar energy they receive is much less than the earth's share—ranging from 1/26 for Jupiter to 1/900 for Neptune. But these studies indicate that these planets may be much more effectively utilising this small energy gift from the sun than does the nearer group of planets, for their atmospheres, as their spectra show, are as blankets retaining energy of the longer heat-waves, and may let little or none pass out in the heat spectrum available to observers on the earth.

These studies further direct attention to that important break between the two groups of planets between Mars and Jupiter, and emphasise the need of its further study, and perhaps from theoretical grounds as well, for when we know what has happened to produce the asteroids and cause this vast change in the planetary bodies, we shall better understand the past of the solar system.

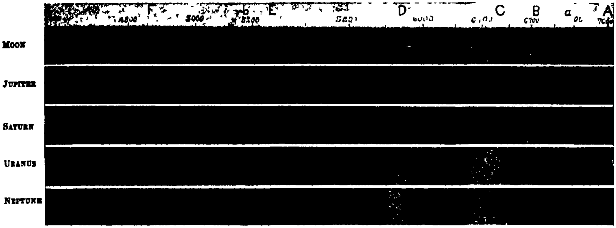

FIG. 4. Spectra of planets and the moon.

Scientific Centenaries in 1934

By Eng.-Capt. Edgar C. Smith, O.B.E., R.N.

THE records of the past year contain accounts of many commemorations of the centenaries of notable men such as Wren, Pepys, Priestley and Trevithick. In some instances the celebrations included the arrangement of interesting exhibitions, the delivery of lectures and the erection of memorials, but in every case they reminded the world of its benefactors and brought to light new information regarding the lives and work of those commemorated. If the sole value of the practice of commemorating centenaries were that it reminded us of great achievements it would be justified, for most men are like Emerson who said: "I cannot even hear of personal vigour of any kind, great power of performance, without fresh resolution." Then, too, we are all debtors of the dead, appropriating from their labours what is pure grain, rejecting what has proved to be chaff and utilising their discoveries and inventions for furthering our immediate ends.

In looking forward once again, it will be found that the centenaries falling within 1934 recall names worthy in every way to be placed beside those brought to mind during the past year. In their own time, and in their particular spheres of activity, few men held higher positions among their fellows than Mendeléeff, Langley, Weismann, and Haeckel, who were all born a century ago, or Jacquard and Telford, who died in 1834. But they only built on the work of their predecessors, and in commencing a short review of the scientific centenaries of 1934, it is of interest to go back to the revival of learning and the days of the Reformation. The outstanding figure in the science of those days was Copernicus (1473–1543), one of whose contemporaries was Otto Brunfels, who died on November 23, 1534, four centuries ago. The son of a German cooper, Brunfels was in turn a Carthusian monk, a Lutheran preacher, a schoolmaster at Strasbourg and a doctor in Berne. His study of herbs caused him to be called a revivor of botany and his name was afterwards given to a genus of plants by Plumier. The year of Brunfels's death saw the birth of another German botanist, Joachim Camerarius (1534–98), son of the learned scholar who reformed the University of Leipzig. The pupil of Melancthon, Camerarius received the degree of M.D. at Bologna in 1562, then settled in Nuremberg and there formed one of the earliest botanical gardens. A French botanist of a hundred years later was Denis Dodart (1634–1707), physician to Louis XIV, a member of the Paris Academy of Sciences and one of the compilers of the "Mémoires pour servir à l'histoire des plantes" published in 1676.

It was but natural that the early botanists should be recruited from the ranks of the physicians, from which came also some of the early chemists Among the medical men of the seventeenth and eighteenth century whose names are indelibly inscribed on the roll of scientific worthies is Georg Ernst Stahl, the bicentenary of whose death occurs on May 14 In 1693, at the age of thirty-three years, he was appointed professor of medicine, anatomy and chemistry in the newly established University of Halle and in 1698 he enunciated the famous phlogiston theory which, embraced in Germany, spread to Sweden, France and England and continued an orthodox article of faith until overthrown by the experiments of Lavoisier In 1716 Stahl removed to Berlin as physician to the King of Prussia, Frederick William I (1688-1740), and there he died Two less famous men who died in 1734 were the French mathematicians Thomas Fantet de Lagny (1660–1734), a foreign member of the Royal Society and for many years royal hydrographer at Rochefort, and Peter Polinière (1671–1734), who it is stated was the first person appointed to deliver lectures on experimental philosophy in the University of Paris

The year 1734 also saw the birth of many individuals who achieved distinction in science and engineering These included Edward Waring (1734-98), F R S , for thirty-eight years Lucasian professor of mathematics at Cambridge, whose "profound researches were not," it was said, "adapted to any form of communication by lectures" , Wolfgang, Baron de Kempelen (1734–1804), the Hungarian statesman and mechanician, who devised an automatic chess player, which was exhibited in London, and a process of printing books for the blind in embossed type , the French agriculturist Francis Rozier (1734–1793), who in 1771 founded the *Journal de Physique et d'Histoire Naturelle* , Thomas Henry (1734–1816), F R S , the chemist, who was first secretary, and later on president of the Manchester Literary and Philosophical Society, and Robert Mylne (1734–1811) the engineer and architect who is buried in St Paul's Cathedral close to Wren Mylne designed the Gloucester and Berkeley Canal, the Eau Brink Cut at Lynn and the first Blackfriars Bridge, the third bridge to span the Thames at London. For a very long period Mylne was the surveyor of St Paul's

Turning to the deaths and births of just a hundred years ago, the list, without being exhaustive, contains many familiar names In 1834 died Jean Nicholas Peter Hachette (1769–1834), a professor at the École Polytechnique, whose development of the descriptive geometry of his colleague, Monge, proved of great value to the constructors of machinery in France , the German astronomer Karl Ludwig Harding (1775–1834), who in 1804 discovered Juno, the third asteroid, and the Swiss physicist Charles Gaspard de la Rive (1770–1834), who like his son Auguste de la Rive was a friend of Faraday On February 26, 1834, Alois Senefelder (1771–1834), the inventor of lithography, died in Munich ; on August 7 Joseph Marie Jacquard (1752–1834), the inventor of the loom for figure weaving, died near Lyons ; on August 19 General Henri Joseph Paixhans (1783–1834), a pioneer in the improvement of artillery, passed away at Metz, and on September 2, Thomas Telford (1757–1834), the great civil engineer, died in Westminster Telford's roads, canals, bridges and docks are to be found in many parts of Great Britain After the death of Rennie he was the recognised head of the engineering profession, and in 1820 he was elected the first president of the Institution of Civil Engineers, a position he held until his death He was buried in the nave of Westminster Abbey and a statue of him is to be seen there in St Andrew's Chapel

So far, all those mentioned have belonged to the western nations of Europe, but of men of science born in 1834 the list may well begin with the names of Langley, Young and Powell, of the United States Samuel Pierpont Langley (1834–1906) will always be remembered for his important theoretical and practical investigations on aeronautics, but he was also distinguished as a physicist and astronomer, and for many years was secretary of the Smithsonian Institution His contemporary, Charles Augustus Young (1834–1908), of Princeton University, was also an eminent astronomer, while Major John Wesley Powell (1834–1902) was, from 1879 until 1902, Director of the United States Bureau of Ethnology and from 1881 until 1894 Director of the United States Geological Survey

These three eminent men were born in the eastern States of America , the birth of the great Russian chemist, Dmitri Ivanowitsch Mendeléeff (1834–1907), carries us to the plains of Siberia, to Tobolsk, where his father was a schoolmaster. Mendeléeff was born on January 27 (O S) or February 8 (N S) and died in 1907 on January 20 (O S) or February 2 (N S) His life and work were the subject of a memorial lecture delivered to the Chemical Society in 1909 by Sir William Tilden Two of Mendeléeff's contemporaries, born in Germany and famous as chemists, were Carl Schorlemmer (1834–92) and Hermann Johann Philipp Sprengel (1834–1906) both of whom, however, spent the greater part of their lives in England, Schorlemmer being the colleague of Roscoe at Owens College, Manchester Sprengel was famous for his invention of the improved mercury air pump and for his work on explosives. Another German man of science born in 1834 was Philipp Reis (1834–74) a pioneer of the telephone whose apparatus was used so early as 1865 by D E Hughes when lecturing before the Emperor of Russia, Alexander II

Leaving the ranks of the workers in physical science for those of the inventors and engineers, mention may be made of Daimler, Wedding, Preece, Woodbury, Vavasseur and Perkins, who were all born in 1834. Loftus Perkins (1834–91), the grandson of Jacob Perkins, was a pioneer in the use of high-pressure steam at sea, and in 1880 built the yacht *Anthracite*, which crossed the Atlantic using steam at 350 lb per sq in ; Joseph Vavasseur (1834–1908) is remembered for his improved method of controlling the recoil of large guns, while Walter Bentley Woodbury (1834–85) was the inventor of Woodburytype and other developments in photography Sir William Preece (1834–1913) was widely known as a distinguished electrical engineer, Gustav Hermann Wedding (1834–1908) was both an honorary member and Bessemer medallist of the Iron and Steel Institute ; while Gottlieb Daimler (1834–1900) will always be remembered as the colleague of Langen, Otto and Maybach, and as the first to construct a high-speed internal combustion engine suitable for road vehicles

In conclusion, passing reference may be made to the approaching centenaries of the birth of Sir John Lubbock, first Lord Avebury (1834–1913) which falls on April 30, 1834, whose writings on primitive man and on bees and ants delighted a large circle of readers, of August Weismann (1834–1914) the German biologist, born on January 17, 1834, who was the first to think out a coherent theory of heredity, and of Ernst Heinrich Haeckel (1834–1919), born on February 16, 1834, who has been spoken of as "probably the most influential advocate of Darwinism"

Experiments in the Stratosphere

IT has recently been reported in the daily Press that an attempt is shortly to be made by balloon ascent to reach higher altitudes than 61,000 ft (pressure 50 mm) claimed to have been reached by Prokofiev and his companions in the U S S R balloon It is to be recalled that observations were made by Regener in 1932 using self-registering apparatus attached to rubber balloons up to a pressure of 22 mm It was reported that the American balloonists Settle and Fordney reached a pressure last autumn of about 64 mm, whilst the minimum pressure from the records of the Belgian flights of Cosyns, Kipfer and Piccard was 73 mm

The new attempt represents a departure from the previous methods in that the observers are to travel in an open basket but will themselves be completely sealed in flexible rubber suits To prevent these from ballooning at low external pressure the suits, adequately supported, will be exhausted down to the minimum that a man can withstand with comfort if he be supplied with sufficient oxygen The advantages claimed are that the great saving in weight by the absence of the heavy gondola of the previous flights will enable the observers to reach greater heights The apparatus has already been tested with safety up to an external pressure supposed to correspond to a height of 90,000 ft —roughly that attained by Regener's balloons These preparatory ground experiments are being conducted by an American, Mr M E Ridge, with the advice of Dr J S Haldane, at the works of Messrs Siebe, Gorman and Co Ltd at Lambeth, London It is assumed that the ballooning of the suit at the greatest height attainable will not incommode the occupant even though he himself is under a very much reduced pressure The observer will be enabled to move about freely and make meteorological and other observations with instruments in contact with the atmosphere

It is true that from the point of view of record breaking, this saving in weight is an important feature, for it was made clear by Dr. M Cosyns, when lecturing in England a short time ago, that the only practical limits imposed turned on the very awkward elongated cigar shape of an extremely large envelope when filled with hydrogen only to a small fraction—one fifth or one tenth—of its capacity on the ground The whole risk lies with the possible entangling of the practically parallel ropes supporting the gondola When once off the ground the mishap cannot be rectified So great was the risk that, in the last Belgian ascent, the balloon was purposely filled with twice as much hydrogen as was required in order to keep the ropes apart, the surplus being discharged en route

Turning now to the instrumental observations, it must be remarked at the outset that the values of *J*, the rate of production of ions per cubic centimetre by the cosmic rays, obtained by the Belgian observers, lie within the limits of those of Regener and agree well with them Those of the stratostat *USSR* are said to agree slightly better with the Belgian than with Regener's results Other interesting experimental results from the Russian source are that the composition of the air is the same at the lowest pressure reached as on the ground, the relative humidity fell from 92 per cent on the ground to 42 per cent on the borders of the stratosphere and that, contrary to expectations, gradients of temperature over a few degrees were experienced within the stratosphere It is noticeable, however, that previous observers have attempted rather too much on each flight, but commenting on the new departure and its relation to previous methods, the barothermograph looks after itself, as does the recording electrometer for obtaining the potential gradient. Perhaps a small advantage would be obtained here in manipulating the leads strung out from the car. The Kolhorster ionisation chamber failed to work on the Belgian flight due to the deposition of body moisture on the insulations, but the advantages of exposing the battery, insulators, electrometers, etc, to the rigorous conditions of the stratosphere are doubtful. Spectrometers for recording the sun and sky light, pyrheliometer for determining the solar constant, air samplers and camera can all be worked in the open. Eyes and ears must unfortunately always be enclosed. The deep purple of the sky noticed by both the Belgian and the Russian observers must always be seen through glass

Of all the observations likely to be made, the greatest promise comes from the projected Wilson chamber experiments by Dr. Cosyns that were mentioned in NATURE of November 25, p 812 The need for a further examination of cosmic rays is urgent, for their origin remains unknown The interesting effect accentuated in the Belgian flights was the difference in the behaviour of the ionisation chamber and the Geiger counter as standardised on the ground with γ-rays from radium and used in the upper atmosphere The relative indications of the counter increase at a greater rate than those of the ionisation chamber, and in the highest altitudes reached, the activity of one has become thrice that of the other The greater attenuation of the ions along the track of the cosmic ray than along that of the standardising β-ray accounts for the comparative falling off of the indications of the ionisation chamber, whilst the counter goes on no matter how small the disturbance This result, however, is deceptive, for as the ground experiments of Blackett and Occhialini have abundantly shown, only a very inadequate part of the life-history of a cosmic ray may be obtained from the study of a localised portion of the track of one of the secondary particles The intrinsic ionisation per centimetre along the track with its secondaries and tertiaries may be just as high as along that of a β-ray It is well known that, of all the instruments, the Wilson chamber set for photographing β-rays and cosmic rays is most delicately poised. Small variations in temperature conditions and expansion ratio with water or alcohol vapour as indicator upset the observations Such an instrument, if it is ever constructed for the purpose, must be used in a closed gondola, on account of its heavy coils for obtaining the requisite magnetic field and extra large chamber for taking in as much as possible of these simultaneous happenings, the non-ionising links, the tracks radiating forwards from diffuse centres consisting of neutral particles and positive and negative electrons and the localised heavy bursts of ionisation supposed to be associated with the complete destruction of a chance heavy molecule

Apart from the investigations in pure science for which such heroic efforts have recently been made and are likely to be made in the future, the reported change in tactics has reopened the question of the feasibility of employing such a flying suit in an open aeroplane flying the stratosphere It is claimed that the control will be easier than from a completely sealed cockpit.

Obituary

MR H R A MALLOCK, F R S

WHEN Mr. Henry Reginald Arnulph Mallock died on June 26, 1933, we endeavoured to find particulars of his career upon which a suitable obituary notice could be based, but were unsuccessful He was an esteemed contributor to our correspondence columns, yet, on account of his dislike for publicity, few personal details were known concerning him, and no one felt able, therefore, to deal adequately with his life and work Dr C V Boys has, however, since contributed to the *Proceedings of the Royal Society* an appreciative account of Mallock's upbringing and some of the products of his fertile brain and mechanical ingenuity We give below an abridgement of this obituary notice and are glad thus to be able to place on record a tribute to a great physicist and engineer

Arnulph Mallock, the youngest son of the Rev. William Mallock, was born at Cheriton Bishop, on March 12, 1851 After leaving school he entered St Edmund's Hall, Oxford, and when he left Oxford he assisted his uncle, Mr W Froude, of Chelston Cross, Torquay, in working out the very beautiful gear of the original ship model tank. In 1876 Mallock went as assistant to the late Lord Rayleigh. He had some doubt whether his mechanical skill would be sufficient to enable him to meet Lord Rayleigh's requirements It would seem that his misgivings were unnecessary for two reasons. He was in fact an accomplished mechanic, capable of the finest instrument construction if he had suitable tools, and Lord Rayleigh was such a genius in devising means almost absurdly simple for conducting experiments of the most crucial character The time spent under that benign influence must perhaps have been the most precious of all in encouraging Mallock, if indeed he needed encouragement, in confidence in first principles where difficult problems were to be met

Mallock was fortunate in having lived among a group of brilliant men in the engineering world —Brunel, Froude, Tower, of spherical engine fame, Baker, Metford and others—and with his very great mechanical skill and considerable mathematical ability and ingenuity, was ready to attack and solve problems as they arose

Perhaps the class of experiment for which Mallock showed especial genius was any in which the smallest movements, tremors, bendings or stretchings had to be determined He designed and either made himself or designed and superintended the construction, by the firms of Troughton and Sims or Adie in particular, of the beautiful instruments with which he examined tremors due to the underground railway, disturbances of St Paul's Cathedral, problems connected with the Forth and Tower Bridges and many more As a civilian member of the Ordnance Committee he wrestled with many of the problems of ballistics

Mallock was also interested in many problems in optics, and in particular he was skilled in dissection under the microscope and wrote many papers on the eyes of insects and the eyes of spiders. For his microscopical mountings Mallock made use of Styrax, on which he contributed two letters to NATURE in 1924. His optical interests naturally drew him to experiment, as so many have done, with the brilliant colours of butterflies' wings and the metallic hues of beetles.

So long ago as 1874 Mallock noticed a colour phenomenon not very conspicuous, but ready to hand for almost everyone As is well known, two sheets of wire gauze or perforated zinc laid one over the other give rise to patterns of the watered silk type but without colour. If, however, only one piece of fairly fine gauze be used and the other is the reflection in an ordinary looking-glass on which it is laid, the patterns are seen as before, but now they are coloured mainly with tempered steel colours The simple explanation is given in the *Proceedings of the Royal Society* in 1918, and it is followed by a note on the colours of tempered steel

Mallock was associated with Mr Metford in the design of rifle bullets and in ascertaining their trajectories He also carried out experiments on the extreme range of rifle bullets with Lord Cottesloe An interesting example of his ingenuity and painstaking research is to be found in his apparatus for measuring the growth of trees. For this purpose he adopted an instrument which he had formerly used for observing changes in the dimensions of cracks on St Paul's and other buildings Another of his enterprises was the design and construction with his own hands of a machine for ruling diffraction gratings This machine is now at the National Physical Laboratory

These notes refer to a few only of Mallock's contributions to physical science out of a great number Fifty-six of his papers appeared in the *Proceedings of the Royal Society* and eighty-nine contributions from him were published in NATURE.

In 1904 Arnulph Mallock married Helena Maria Caroline Finlay, of Castle Toward, Argyllshire. In his last years with rapidly increasing blindness her devotion did much to alleviate his distress, for his mind and interests remained acute but first his beloved microscope and gradually all print ceased to be available to him.

WE regret to announce the following deaths:

Dr Howard Ayers, president of the University of Cincinnati from 1899 until 1904, formerly professor of biology in the University of Missouri, on October 17, aged seventy-two years.

Prof Erwin Baur, director of the Kaiser Wilhelm Institut fur Zuchtungsforchung, Berlin, on December 2, aged fifty-eight years

Prof Edwin S. Crawley, emeritus professor of mathematics in the University of Pennsylvania, known for his work on the geometry of curves, on October 18, aged seventy-one years.

Mr Edward Evans, formerly in charge of the science classes at Burnley Municipal College, author of "Botany for Beginners", on December 23, aged seventy-eight years

Prof J Cossar Ewart, F R S, formerly regius professor of natural history in the University of Edinburgh, a pioneer in animal breeding research, on December 31, aged eighty-two years.

Prof T Swale Vincent, formerly professor of physiology, University of London, an authority on the ductless glands, on December 31, aged sixty-five years

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News and Views

New Year Honours

THE New Year Honours List includes the following names of scientific workers and others associated with scientific work · *K C V O.:* Sir Richard Glazebrook, chairman of the Aeronautical Research Committee, 1908–33 *Knights* Dr S C. Cockerell, director of the Fitzwilliam Museum, Cambridge; Mr. G. Evans, principal of the Imperial College of Tropical Agriculture, Trinidad; Dr. Kenneth Lee, chairman of the Industrial Grants Committee, Department of Scientific and Industrial Research; Col. C. E Merrett, president and trustee of the Royal Agricultural Society, State of Victoria; Prof. Robert Muir, professor of pathology, University of Glasgow; Dr C. T. Hagberg Wright, secretary and librarian of the London Library. *C.S.I* · Brigadier R H. Thomas, lately Surveyor-General of India. *C M.G.* · Prof. R. E. Alexander, director of Canterbury Agricultural College, Lincoln, near Christchurch, New Zealand; Mr. A. Holm, lately director of agriculture, Kenya. *C.I.E.:* Lieut.-Col. A. D. Stewart, director of the All-India Institute of Hygiene and Public Health, Calcutta; Lieut-Col. Ram Nath Chopra, professor of pharmacology, School of Tropical Medicine and Hygiene, Calcutta *C B.E :* Mr. J. S Buchanan, deputy director of technical development, Air Ministry, Mr. R G Hatton, director of the Horticultural Research Station, East Malling, Kent *O B E* Mr G. H J Adlam, senior science master, City of London School, Mr. M. C. C. Bonington, lately divisional forest officer and forest development officer, Andamans, Mr. C Coles, principal of Cardiff Technical College; Mr. D. Mackay, for service in connexion with scientific exploration and survey in the interior of Australia; Prof. W. Makower, professor of science, Royal Military Academy; Dr. P. D Strachan, superintendent, Leper Settlement, Botsabelo, Basutoland; Mr. H B. Thomas, deputy director of surveys, Uganda Protectorate; Mr. A. H. Unwin, conservator of forests, Cyprus. *M.B.E.*. Mr. A. S. Buckhurst, assistant in the Plant Pathological Laboratory, Harpenden; Mr. B. J. Hartley, district agricultural officer, Tanganyika Territory; Mr. C. A. Pinto, curator in the Zoological Gardens, Lahore, Punjab; Mr. M. J. S. Rosair, extra assistant conservator of forests, Burma,

Science News a Century Ago

WHEN we were arranging for the publication during 1934 of notes on topics and events of scientific interest week by week a century ago, and of industrial changes or incidents in public affairs having contacts with science, we invited several contributors familiar with particular fields to send us occasional notes for this new "Calendar" of past occurrences. One of these contributors, who has special knowledge of social and political subjects, has carried his mind back to the beginning of the year 1834, and has sent us what might have been editorial comments upon some matters then under discussion. The columns of "Science News a Century Ago", which we propose to publish throughout the year, will not usually be of the nature of comments but rather selected notes from papers or other publications during 1834. There is, however, so much of interest in our correspondent's retrospective remarks on the first day of that year that we have no hesitation in reproducing them below. The notes accurately represent the atmosphere at the time, and they remind us, among other things, that the United States had its gold problem then as now, and also that Empire communication as we know it to-day had no existence then.

January 1, 1834

"IT is natural on New Year's day to look both backward and forward—to take stock, and even to speculate as to the future. This coming year will bring the commencement of the fifth year of the reign of His Gracious Majesty King William IV, and it finds that eminent Whig, Earl Grey, who some two years ago piloted the Reform Bill to the Statute Book, still in the saddle as Prime Minister. Perhaps the most notable piece of legislation during the year which has just closed was the enactment of the abolition of slavery in Great Britain and its Colonies, despite the opposition of that rising hope of the younger Tories, Mr. William Ewart Gladstone, M.P. for Newark. Probably a century hence this measure will be regarded as one of the boldest and most enlightened efforts of the Reformed Parliament, as well as one of its earliest. Who can tell?"

"LOOKING abroad, we cannot fail to be interested in what goes on in the United States of America. Their recent severance from the British sovereignty, and their close ties of consanguinity, militate against indifference to their welfare in this country. Like most young communities, they have their own troubles to face; and, economically, the welfare of the whole world has been adversely affected by the prolonged Napoleonic wars. We feel the pinch here, even yet, most acutely, but our economic fabric is more firmly established than theirs. It is an object-lesson in the far-reaching effects of these factors that this overseas community, situated so far from the seat of the Napoleonic conflagration, is nevertheless so seriously affected. American citizens continue to be agitated by the contest which began last year as to the legality of the conduct of their President in withdrawing the public deposits from the National Bank. Meanwhile, the importation of gold into the States has assumed unprecedented proportions since January, 1833. Some there are who attribute all these happenings to a republican form of government; but that is probably too sweeping a generalisation. The States are young, vigorous, and are as yet developed to nothing like their full extent. On the other hand, many believe that they have before them a future the brilliance of which has never been matched in the Old World. Time alone can show. Anyway, these happenings are of absorbing interest, and make us increasingly impatient for the arrival of each sailing packet with mails. In some quarters this impatience takes the form of suggesting that matters would be improved if the new motive agent—the steam engine—could be brought to such a state of perfection as to replace sailing ships by steam ships; but that day is not yet, and the Atlantic is a turbulent piece of water to be conquered by so new an invention."

Centenary of Philipp Reis, 1834–1874

ON January 7 occurs the centenary of the birth of the German physicist, Johann Philipp Reis, one of the earliest pioneers of the telephone. Reis was born in Gelnhausen, and died at Friedrichsdorf near Homburg on January 14, 1874 at the early age of forty years. Left an orphan, he had to struggle against many difficulties and it was while an apprentice to a painter that he laid the foundation of his knowledge of chemistry and physics. Eventually he was offered a post as a teacher at the Institut Garnier in Friedrichsdorf, which he had attended as a boy. It was in his own private workroom that he made the apparatus which he called the "Telephon". His work was based on the true theory of telephony, and he probably designed ten distinct forms of transmitter and four forms of receiver. On October 26, 1861, he exhibited his apparatus before the Physical Society of Frankfort-on-Main and a year or two later lectured on it at Giessen. His apparatus was also placed on the market, and when D. E. Hughes went to Russia in 1865 in connexion with his printing telegraph, he took one of Reis's telephones with him and exhibited it to the Emperor Alexander II at Czarsko Zelo. But in spite of the correctness of his views and his ingenuity, Reis failed to impress others of the value of his invention. Towards the end of the 'sixties he was attacked by consumption and this led to his early death. He passed away entirely unnoticed, but after the telephone came into common use his country attempted to make some amends for the neglect he had suffered, and the Government erected a monument over his grave in the cemetery at Friedrichsdorf. His biography was written in 1883 by Silvanus Thompson, and on January 7, 1884 the Electrotechnische Gesellschaft of Frankfort held a special meeting followed by a banquet to commemorate the fiftieth anniversary of his birth.

Science and Psychical Research

IT was suggested in a leading article in NATURE of December 23, that investigations in the field of abnormal psychology, and the alleged physical phenomena said to accompany particular states of mental dissociation, might appropriately be taken up by a department of a university or other responsible scientific institution as subjects of post-graduate research. Since then we have received a circular relating to the formation of a body with the title of the International Institute for Psychical Research, "for the furtherance of knowledge in regard to psychic phenomena". The president is Prof. Elliot Smith, and two of the vice-presidents are Prof. Julian Huxley and Prof. E. W. MacBride. The chairman of the executive committee is Mr. J. Arthur Findlay, a well-known business man in Glasgow, whose book "On the Edge of the Etheric", published last year, described a series of sittings with a Scottish "direct voice" medium. Judging from this book, Mr. Findlay has little conception of the critical attitude of science towards the evidence which he presents and the explanations he gives of the phenomena he describes. In the words of our reviewer of his book: "But from reading Mr. Findlay's records the scientific method might be thought not to exist. He seems to have no appreciation of the implications underlying many of his remarks; no desire to see the phenomena described in accurate and scientific terminology."

Perhaps the men of science who have become office bearers in the new organisation will be able to see that whatever investigations are undertaken are more in accord with what science demands than are those the explanations of which are accepted by Mr. Findlay. In any event, we need scarcely say that we do not regard the new body as satisfying the conditions of psychical research in a university or similar institution referred to in the leading article in our issue of December 23. Its aims and intentions do not seem to us to differ essentially from those of the Society for Psychical Research or from Mr. Harry Price's National Laboratory for Psychical Research.

The Sea-Fish Commission

In accordance with the provisions of Section 5 of the Sea-Fishing Industry Act, 1933, the Secretary of State for Home Affairs, the Secretary of State for Scotland, and the Minister of Agriculture and Fisheries, have appointed a Sea-Fish Commission consisting of the following: Sir Andrew R. Duncan (chairman), Viscount Wolmer, M.P., Mr. Francis Beattie, Mr. Edwin Fisher, and Mr. Lawrence Neal. We note with regret that no man of science has found a place on this Commission, notwithstanding that some of its functions make scientific knowledge desirable—particularly piscicultural knowledge. To emphasise this desirability, it may be mentioned that the functions of the Committee will include the investigation of matters relating to the storage and treatment of fish after landing; and it is also inevitable that pre-landing problems will call for investigation. It is most disappointing that the tendency to ignore scientific workers in the personnel of various kinds of commissions and committees should still persist; it is the more difficult to understand when we remember that some members of the Cabinet have hitherto shown themselves to be scientifically minded.

"Codex Sinaiticus"

An appeal to the public for the amount necessary to acquire the "Codex Sinaiticus" for the British Museum could not fail to meet with a generous response, especially when backed by the offer of the Government to provide an amount equal to that raised by public subscription up to a limit of £50,000. The unique place of the Bible in English life and literature renders it peculiarly appropriate that of the two oldest and most valuable sources of the Greek text, the "Sinaiticus" and the "Vaticanus", one should find an abiding resting place beside the later "Alexandrinus" in the British Museum, while the other lies in Rome. The price to be paid to Russia is undoubtedly large, even though the method of payment will lighten the burden; but it cannot be held too high for the enhanced prestige which it will confer on Britain's greatest national museum and the increased opportunities it will afford British scholarship in biblical studies, which already stands high. The crowds which thronged the British Museum in the days following the Christmas holidays, for a brief glimpse of the manuscript—by the end of the week there had been 20,000 visitors—and the readiness with which small subscriptions poured in, were an eloquent testimony of the extent to which the imagination of the public outside scholastic and learned circles had been touched by the interest of this document of almost unique importance in the history of civilisation.

Archæological Exhibitions at the British Museum

Two loan exhibitions were opened on January 4 in the Department of British and Mediæval Antiquities, British Museum, at the head of the main staircase, containing respectively pre-Crag flints from Suffolk and palæoliths from the Raised Beach and Coombe Rock of Sussex. Mr. Reid Moir's exhibit is intended to show at least four periods, indicated by different patinations, for the rostro-carinates and other types from the Bone-bed at the base of the Crag; and one example in particular, which has a sandy deposit adhering, is held to prove its flaking prior to the Diestian deposits of the Lower Pliocene. Excavations by Mr. J. B. Calkin at Slindon Park, between Chichester and Arundel, have produced a series of worked flints which can be dated geologically, as some (mostly rolled) were found in the upper level of the Raised Beach there (surface level 135 ft. O.D.), others on the top of the Beach and in the lower part of the Coombe Rock above it. Sufficient specimens have been found to prove that the Raised Beach dates from late St. Acheul times, and the Coombe Rock covered a Levallois working-floor as at Northfleet. The Raised Beach a little south, at a height of 80-90 ft. O.D., has not produced enough to establish its identity.

Archæological Exploration in Persia

MUCH as it may be regretted that the British School of Archæology in Iraq (Gertrude Bell Memorial), in accordance with the decision announced at the end of last season, will not itself be responsible for expeditions of archæological exploration in its special province, pending more satisfactory arrangements under the antiquities laws of the country, the announcement of the grant of £500 from the funds of the School to Sir Aurel Stein towards the cost of excavating mounds in south-western Persia will afford archæologists some measure of consolation for the suspension of activities in northern Iraq The archæological work which Sir Aurel proposes to carry out with the assistance of this grant is in continuation of certain investigations which he has made during the past two seasons in south eastern Persia, where a number of early sites were examined He will cover a field in which it is anticipated that much needed evidence will be obtained bearing on the relations of the early culture of Elam and possibly, it is hoped, the relationship of the Indus valley civilisation to that of western Asia—at the moment the most intriguing of the problems of Middle Eastern prehistory It is also announced that the British School has made a grant of £100 towards the expenses of the short season of excavation at Ur which is now opening

Prehistoric Art in the Libyan Desert

SHOULD preliminary announcements be confirmed by subsequent examination of the evidence, a further link in the relations between the prehistoric art of northern Africa and the Bushman art of South Africa is afforded by discoveries made by Dr Leo Frobenius in the Libyan Desert Dr Frobenius, who has just returned from his eleventh expedition to Africa, reports, according to a Frankfort dispatch in the *Times* of December 28, that he has discovered in the Auwenat massif a centre of supplies for the stone implement factories of various parts of North Africa, with evidence in the form of rock drawings, stone tools and traces of pottery of two distinct cultural periods, the older coming from Lower Egypt in the north, the later, of a character hitherto unknown, coming from the south Moving south to the oasis of Selimah in northern Kordofan, Dr Frobenius discovered a new southern culture with a ceramic industry dating from between 6000 and 4000 B C in an area which he regards as having been the valley of a third or 'Yellow' Nile On the route to this centre, 44 stone implement factories were discovered as well as several hundred rock-drawings, representing men and animals engaged in various activities It is maintained that these discoveries throw a new light on the relations of the art of North Africa, East Spain and South Africa, while the dating of the 'factories' makes it possible to determine the direction of culture drift

Presentation to Sir Herbert Jackson, K.B.E., F.R.S.

THE Council of the British Scientific Instrument Research Association held an informal luncheon at the Connaught Rooms on December 21 in honour of Sir Herbert Jackson, who occupied the position of Director of Research of the Association from its beginning in 1918 until July 31, 1933. Some thirty members of council and friends, representing all sides of the scientific instrument industry, attended. After the luncheon, Sir Herbert Jackson was presented with a gold minute-repeater watch and a vase of carved white jade, and Lady Jackson received a pair of ivory-backed brushes and a mirror. Mr. Conrad Beck, in proposing the toast of Sir Herbert and Lady Jackson, spoke of the valuable work which Sir Herbert Jackson had done and of the friendly relations which had existed between Sir Herbert and all the members of the Association Sir Frank Smith and Mr. H. T Tizard both referred to the wide range of Sir Herbert's activities and to the wealth of helpful suggestion which he could invariably bring forward in discussions on non-technical as well as on technical matters In the remarks made by Mr R S Whipple, Mr F. Twyman and Mr. J. Hasselkus, special tribute was paid to Sir Herbert's power of inspiring self-confidence in those with whom he came into contact, and to the encouragement he had always given to instrument makers not to be satisfied with an instrument that was good enough, but to produce an instrument which was really outstanding High tribute was paid also by all the speakers, to Lady Jackson, who shares the affection in which Sir Herbert himself is held Sir Herbert Jackson, after thanking the council and members of the Association for their expressions of appreciation and for their gifts, referred to the assistance and co operation which he had received from the industry itself, and to the spirit of enterprise which animated the industry without these it would have been possible to do but little

The Physical Society's Exhibition

THE catalogue of the Annual Exhibition of Scientific Instruments and Apparatus to be held at the Imperial College by the Physical Society on January 9-11 is an octavo volume of 184 pages, the trade section occupying 148, the research and experimental section 26, and the index to the trade section 5 pages Reference to the exhibits, the stands and the firms exhibiting has been greatly facilitated by the number of the stand and the name of the firm being printed at the head of each page A considerable number of illustrations are provided, but there is still a number of firms satisfied with showing little more than the outside appearance of a piece of apparatus, for example, a box on the top of which are a handle for carrying, a small window and a few terminals, instead of a diagram of its mechanism or a view of its interior As a contrast, the descriptions in the research and experimental section are full of the information which a potential user of an instrument or a method requires in order to determine whether it will suit his purpose. In the trade section, instruments which have not been exhibited previously are marked with an asterisk and on the stalls with a red star. Many of them are connected with branches of physics which have in recent years become important in industry, for example, detectors of dangerous gases in air, X-ray equipment, colorimeters, valves and photoelectric cells. Others introduce new methods into old fields, for example, an engraving machine which seems likely to displace etching, a gas tube which leaks an electrostatic charge away if the potential exceeds a fixed value, a polish measurer working photoelectrically, and an optical tube of small diameter for examining the inside surfaces of long tubes. For this device the name "introscope" has been invented. Other new names are "grapher" for recorder, "hygrograph", "opacimeter", "stormograph" and "stormoguide" for forms of barograph, any of which may at some future date find places in a new Oxford dictionary.

The late Mr. W. W. Ouless, R.A.

THE death of the distinguished portrait painter, Mr. W. W. Ouless, on December 25, at the age of eighty-five years, recalls his skill in the portrayal, in much faithfulness, of many well known men of science. An oil painting of Charles Darwin, a treasured possession of the family, was executed in 1875, and a replica by the artist himself hangs in Christ's College, Cambridge. Considered by Darwin's children to be an outstanding presentment, it was etched very successfully by M. Rajon. It is recorded in the "Life and Letters" that the portrait was finished at the end of March 1875, that Darwin felt the sittings a great fatigue in spite of Mr. Ouless's considerate desire to spare him so far as was possible. In a letter to Sir Joseph Hooker, Darwin remarks, "I look a very venerable, acute, melancholy old boy; whether I really look so I do not know." Another portrait by Ouless was of Sir William Bowman, F.R.S. (1816–1892), eminent in ophthalmic surgery. Bowman's admirers at home and abroad specially engaged the services of Ouless for this work, whilst at the same time they arranged for a reprint of all his scientific treatises, with Prof. Burdon Sanderson and Mr. Hulke as supervisors of the issue. In 1928 Ouless painted a portrait of Sir Arthur Keith.

Asiatic Society of Bengal

ON January 15, 1934, the Asiatic Society of Bengal, which was founded under the name of the "Asiatick Society", on January 15, 1784, by Sir William Jones, will reach the age of a hundred and fifty years. The Society was founded to inquire into the history, civil and natural, the antiquities, laws, arts, sciences and literature of Asia, and during its long existence its usefulness has spread far and wide, and it has to its credit a wonderful record of achievements. The president and council of the Society have decided to celebrate, on January 15, the 150th anniversary of this foundation. The anniversary programme will consist of a conversazione in the Indian Museum, and a banquet in the hall of the Society, followed by a special anniversary meeting to receive addresses from learned societies and to elect a number of honorary anniversary members of the Society. In connexion with the centenary celebration in 1884, a volume depicting the progress of letters and science during the preceding hundred years was published; and it has been decided to undertake the preparation of a special volume on similar lines covering the period of the last fifty years.

The Electronic Organ at Poste Parisien

AMONG the many applications of the thermionic valve is the invention of a new type of organ, which makes use of valve-produced electrical oscillations converted into sound through the agency of a loud-speaker. Many types of such 'electronic' organs are being developed in different parts of the world and some of these are already being used for broadcasting purposes. An illustrated description of this type of organ installed at the Poste Parisien broadcasting station is given in the *Wireless World* of December 22. This organ has three manuals, each of four and a half octaves, together with two and a half octaves of pedals, making a total of about two hundred notes. For each of these notes a three-electrode valve is provided with its oscillatory circuit, comprising a fixed condenser and an iron-cored inductance, tuning being effected by a screw adjustment of the iron core. Another two hundred valves are fitted in the amplifiers which feed thirteen loud-speakers. A number of auxiliary instruments, mostly pneumatically operated, are fitted to produce the various noises and 'effects' required in connexion with broadcasting programmes. A notable feature of the new instrument is the 'swell' action, which is controlled by a pedal-operated rheostat applied to the whole of the organ, and not only to one or two manuals as in the case of the normal organ. The oscillations produced by the first valves are very rich in harmonics and by switching in various filter circuits the quality of the tones emitted can be varied to a considerable extent. The whole instrument is very compact and, for broadcasting purposes, the loud-speakers are not required in circuit since it is obviously unnecessary to convert the electrical into acoustical energy in order to control a wireless transmitting station.

Stream-line Form in Motor-Cars

EXPERIMENTS carried out on models in a wind tunnel by R. H. Heald, of the U.S. Bureau of Standards, shows that the trend towards stream-line form in the construction of modern cars leads at high speeds to a substantial saving of power and therefore of petrol. The tests show the air resistance of the 1933 car is more than twice that of a completely stream-lined car of the same frontal area. According to a mail report from Science Service, the tests were made on models ranging from one quarter to one fifteenth natural size with wind velocities varying from thirteen to seventy miles per hour. Some of the models were of cars of the past, but two represented cars which may be used in the future. The 1933 model had disk wheels, exposed bumpers, fenders, head-lights and a spare tyre. One of the models of the motor-car of the future had a wind-shield which made an angle of 45° with the horizontal, the chassis was rounded at the top and back and the lines were smoothly moulded. The other model had the whole upper part rounded, was blunt at the front and tapered at the back Mr. Heald computes from his results that, at 60 miles per hour, the 1922 Sedan requires 27 h.p to overcome air resistance, 26 h p is taken by the 1928 Sedan and 18 h p for the 1933 model The two stream-lined models took 8 and 6 h p respectively At 48 miles per hour it was found that the horse power expended on air resistance was halved and at 76 m p h it was doubled Mr. Heald concludes that the 1933 motor, shorn of its projecting bumpers, head lights and spare tyre, and fitted with a rounded top and sloping wind shield, would consume 10 h p less at 60 m p h and 20 h p less at 70 m p h

Earthquake Insurance in New Zealand

According to a message published in the *Times* of December 21, the Judicial Committee of the Privy Council in New Zealand has decided that, under the Workers' Compensation for Accidents Act, compensation could be claimed for the death or injury of labourers engaged in their occupations during the recent Hawke's Bay earthquake The insurance companies stated that their liability in the event of a great disaster would be so serious that they could not undertake the risk The Government accordingly introduced a measure to remove employers' liability in such cases in future This proposal being opposed, a compromise was reached limiting the total liability of the companies to £50,000 in a single earthquake or in a series of earthquakes lasting for seven days

Teaching of Biology in South Africa

An address by Dr E P Phillips on "The Teaching of Biology", read to the South African Biological Society, appears in the Society's Pamphlet No 6, 1933 Dr Phillips advocated an introduction to biology in the schools by easy stages, which would give pupils an insight into biology as a concrete whole and not as isolated facts His scheme, beginning like many others, with the differences between living and non living, leads gradually and finally to knowledge of elementary human physiology, and includes information on the great generalisations of biology The discussion which followed showed a widespread feeling that biology is not satisfactorily taught in schools, and Dr Janse placed his finger upon the weak spot in the present system when he made a plea for better trained teachers in biology

Lovibond Comparator with B.D.H. Indicators

Included in the "Catalogue of B D H Fine Chemical Products", recently received from the British Drug Houses, Ltd, London, N 1, is a leaflet describing the Lovibond comparator for use with B.D H indicators. The apparatus consists of a metal case, opening like a book, and furnished at the back with an opal glass screen and two partitions to take the test-tubes containing the liquid under examination. The standard colour glasses, nine in number, are fitted into a flat disc which may be rotated in the front half of the case, which contains two holes, in front of the test tubes. By rotating the disc, a colour glass is brought into view in front of one test-tube, containing the liquid only, through the other hole the test-tube containing liquid with the correct amount of appropriate indicator added is visible simultaneously The colour comparison can thus be quickly made The pH value of the colour appears at a third hole in the front of the case Discs are available for different indicators of pH 2 8–9 6 and also for B D H Universal indicator, pH 4-11

Eclipses of the Sun in 1934

There will be a total eclipse of the sun on February 13 14, which is invisible at Greenwich The sun will rise eclipsed over Borneo, and the path of totality runs across the Pacific Ocean without crossing any land except a few very small islands Oroluk Island, Losap Island and Wake Island lie on the path of totality No British expedition has been organised to observe the eclipse from any of these small islands In Borneo the eclipsed sun will, of course, be so low down that no useful spectroscopic observations can be made The second solar eclipse which will take place in 1934 will be an annular eclipse on August 10, also invisible at Greenwich The track crosses South Africa from Mossamedes to Inhambane

Announcements

A conference on atomic physics will be held in 1934, under the auspices of the Physical Society It will be opened by Lord Rutherford, and will probably extend over two days at least, some of the meetings being held in London and some in Cambridge

We regret that in referring to "Street Traffic Flow" by Mr Henry Watson in Nature of December 30, p 987, the price quoted was 31*s* net Messrs Chapman and Hall, Ltd, inform us that the price of the book is 21*s* net

Applications are invited for the following appointments, on or before the dates mentioned —A junior technical assistant for the Directorate of Ordnance Factories, War Office—The Permanent Under-Secretary of State (C 4), The War Office, London, S W 1 (Jan 15) A chief technical assistant to the electricity undertaking of the Metropolitan Borough of Poplar —The Town Clerk, Council Offices, High Street, Poplar, E 14 (Jan 19) A principal of the Croydon Polytechnic and Evening Institutes—The Education Officer, Education Office, Katharine Street, Croydon (Jan 31) A specialist serologist in the Union of South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London, W C 2 (Feb 6) A principal of the Grimsby Technical Evening School—The Secretary, Education Offices, Grimsby A chemist under the Sudan Government, at Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S W 1

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Positive Electron Tracks

I. CURIE-JOLIOT, Anderson and Neddermeyer, Meitner and Philipp have been able to observe positive electrons produced by the hard γ rays of thorium C″ in lead and other elements. An attempt to explain the phenomenon has been made by Oppenheimer and Plesset, who consider it as a kind of photo-effect from the levels of negative energy, the absorption of a quantum of light energy resulting in the formation of two material particles, a negative and a positive electron. A pair of these electrons, formed in the gas of a Wilson chamber, is to be seen on one of the photographs published by Curie-Joliot[1].

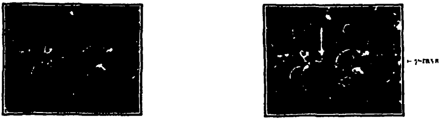

FIG. 1. Stereoscopic photographs of electronic tracks.

So early as 1931, I myself observed similar cases in the course of my researches on the Compton effect. In this, the hard γ-rays of thorium C″ were used and a Wilson chamber placed in a magnetic field. One of several pairs of stereoscopic photographs which show the phenomenon is reproduced as Fig. 1.

The origin of the track which is to be seen in the middle of Fig. 1 can be interpreted in two different ways:

1. The track may be due to a single negative electron which first moved along the arc of the larger circle (counter clock-wise), lost most of its energy in a non-elastic collision (Krammer's jump), then suffered a deviation by about 180° and finally pursued its way along a curve of smaller radius, of which a whole turn is shown.

2. The two branches may belong to two electrons of different sign issuing from the same point (which is marked by an arrow) and deviated by the magnetic field in opposite directions.

In the case illustrated in Fig. 1, as well as in three other analogous cases, the radius of the electronic tracks can be determined with comparative accuracy; therefore we are able to verify whether the energy is such as can be deduced from theoretical considerations on the assumption that the effect is due to photons of the line $h\nu = 2620$ ekilov[2].

As is well known, the sum of their kinetic energies is:

$$h\nu - 2mc^2 = 1600 \text{ ekv}$$

The table below contains the values measured for four photographs.

No.	ϵ_+	ϵ_-	$(\epsilon_+ + \epsilon_-)$	Angle formed by the two electrons	Angle formed by the γ-rays and the vector representing the sum of the impulses of both electrons
1*	1150	450	1600	20°	11°
2	1000	575	1575	22°	2°
3	1350	325	1675	90°	12°
4	675	975	1650	76°	165°

*Reproduced in Fig. 1.

The good agreement of the calculated and the observed data is much in favour of the second assumption.

In the fourth case, the first assumption does not hold at all, since it requires the collision to be accompanied by an increase of energy.

It is interesting to note that, in three cases out of four, the ratio ϵ_+/ϵ_- gives approximately the same value, something between 2 and 4, the same as in the case observed by Curie-Joliot. It appears as if, on the average, the positive electron were endowed with a considerably greater energy. For heavy elements, as in Curie-Joliot's experiments, the energy appears to be divided into nearly equal parts.

The study of the series of photographs, including the four cases of the above table, showed that the total number of Compton electrons corresponding to the line 2620 ekv. is about 700. It may be said that, in the case of light atoms (nitrogen, in particular) the number of electronic pairs is of the order of 1 per cent of the Compton electrons, in good accordance with the value computed by Oppenheimer and Plesset[3].

In general, the above-mentioned facts are in fairly good agreement with the computations of these authors as well as with Curie-Joliot's results concerning the variation of the effect with the atomic number of the element.

FIG. 2. Stereoscopic photographs of electronic tracks.

The data of Curie-Joliot seem to indicate that the ratio, number of pairs/number of Compton electrons, is proportional to the atomic number, as also follows from the Oppenheimer-Plesset theory.

II. The stereoscopic photograph reproduced as Fig. 2 represents apparently a case never observed before, namely, a pair $\epsilon_+ + \epsilon_-$, produced by a β particle. On the left is seen the track of the primary particle (ϵ_-), at the end of this track, marked by an arrow, two new tracks can be observed belonging to comparatively slow electrons emitted in opposite directions and deviated by the magnetic field in a different way. Each of the two electrons possesses an energy of about 100 ekv. The energy of the primary electron does not allow of very accurate evaluation, but it is sure to approach some 1200 e v. (E) The energy balance is thus seen to be correct.

$$E = 2mc^2 + \varepsilon_+ + \varepsilon_-$$

(After collision, the kinetic energy is carried only by one of the two negative electrons which take part in the process)

During the impact, the impulse of the primary particle is wholly passed on to the nucleus and the latter acquires sufficient energy to produce several ionisations At the intersection of the three tracks there is to be seen a distinct thickening due, perhaps, to the 'recoil' of the nucleus

Among my remaining photographs, I have one very similar to that of Fig 1, but it is less to be relied upon, since, on it, the electronic track lies on the boundary of the illuminated region

The total length of the electronic tracks I have hitherto examined amounts to several hundreds of metres The probability of the effect is thus seen to be rather high, in any event, it is much above the corresponding theoretical value found by Furry and Carlson[4]

Assuming the above interpretation and Dirac's conception of the positron to be correct, an intense 'annihilation radiation' should be expected to take place from the anticathode under the action of an electronic beam if the velocity of the electrons exceeds 1000 ekv

D SKOBELTZYN

Physical Technical Institute,
Leningrad
Nov 6

[1] I Curie and F Joliot, *J Phys*, 4, 429, 1933
[2] C D Ellis, *Proc Roy Soc* A, 138, 318 1932
[3] J R Oppenheimer and M S Plesset, *Phys Rev*, 44, 53, 1933
[4] W H Furry and J F Carlson, *Phys Rev*, 44, 237, 1933

Combination of Proton and Neutron

SOME time ago, experiments were made, in collaboration with Dr. L H Gray, in which the scattering of neutrons by various materials was detected, with the aid of a high pressure ionisation chamber containing nitrogen[1] The results were on the whole compatible with the view that the observed ionisation was due to neutrons scattered in all directions by elastic collisions with nuclei, and various experimenters have confirmed this[2] Measurements made with paraffin wax and liquid hydrogen (the latter kindly provided by Dr P Kapitza) showed, however, the surprising result that radiation was freely emitted at angles of 120°–180° to the direction of the incident neutrons It is clearly impossible for neutrons to be scattered at angles greater than a right angle by single elastic collisions with protons, and calculation shows that multiple scattering cannot explain the observed effects

Recently the experiments have been resumed, and the scattering in the backward direction from paraffin has been measured in terms of the ionisation produced in two high-pressure chambers filled with argon and hydrogen A given intensity of gamma-radiation produces an ionisation current twelve times greater in argon than in hydrogen, while for neutrons the ratio is rather less than unity Accordingly it was possible by comparing measurements in the two gases to distinguish between gamma-radiation and neutrons When allowance was made for the carbon present in the paraffin (by observation of the scattering from graphite) the results showed that the radiation scattered from hydrogen was entirely gamma-radiation Absorption measurements extended up to a thickness of 3 4 cm of lead indicated that the scattered gamma-radiation was heterogeneous and of mean quantum energy of two to four million volts.

No mechanism is known to account for the backward scattering by hydrogen of the hard gamma-rays present in the radiation from the source of polonium plus beryllium, and experiments with thorium C″ gamma-rays failed to show any scattering under similar conditions The most plausible way of explaining the results is to suppose that in some of the collisions between the neutron and proton, the particles combine to form H^2, the heavy isotope of hydrogen The combination will result in the emission of energy in the form of gamma-radiation, and assuming that momentum is conserved, the amount of radiation will be roughly equal to half the kinetic energy of the neutron plus the mass defect of the H^2 nucleus (about one million volts, taking the mass of the neutron as 1 0067) The energy deduced experimentally for the gamma-radiation would agree with a neutron energy of two to six million volts This is of the right order, for the majority of the neutrons from beryllium and polonium have energies between two and four million volts, and some have more.

It is to be expected that H^2 nuclei produced in this way could be observed in the expansion chamber as short tracks confined to directions within a few degrees of the direction of the neutrons It is possible from the present data to make only a very rough calculation of the number of such tracks compared with the number of recoil protons, but it is estimated that the proportion may be as high as one quarter

These experiments have been made with the active support of Dr J Chadwick, to whom I am much indebted I wish especially to thank him for preparing the polonium source, and for suggesting the interpretation of the experiments

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Dec. 22

[1] Chadwick, *Proc Roy Soc*, *A*, 136, 704, 1932
[2] de Broglie, *C R*, 194, 1616, 1932 Dunning and Pegram, *Phys Rev*, 43, 497, 1933

Cosmic Ultra-radiation and Auroræ Boreales

RECORDS of the ionisation in a closed vessel, caused mainly by the cosmic ultra-radiation, have been obtained at Abisko in northern Sweden (lat. 68° 21′ N) during two periods · October 1929–July 1930 and September 1932–July 1933[1]. During the first period, a Kolhörster apparatus, placed within an iron shield 6–11 cm. in thickness (free opening upwards), was used, during the second period, a Steinke apparatus, placed within a lead shield 10 cm. in thickness in all directions, was used. Every second fortnight the Steinke apparatus recorded, however, with the shield open upwards The results of both periods have been compared with simultaneous observations of the auroræ boreales and also, for the first period, with the simultaneous magnetic records of the Geophysical Observatory of Abisko[2].

The ionisation found during auroræ of different types and of different extension over the sky of the first period is shown in Table 1. It is seen that the ionisation *increases* during auroræ and also with their extension to the southern part of the sky The material of the first period is unfortunately not great, but the indication in Table 1 of an increase of the ionisation during auroræ is strongly supported by the similar increase of the ionisation during magnetic disturbances in the same period, which was shown in an earlier paper[2].

Table 1.

Extension over the sky	Clear sky, no aurora	Homogeneous arcs	Arcs with rays	Diffuse surfaces	Pulsating aurora	All types
Northern sky	2 68(12)	2 74(11)	2 79(7)	2 95(1)	3 12(1)	2 79(20)
Southern sky		2 83(8)	2 83(19)	2 79(7)	2 88(7)	2 83(41)
	2 68(12)	2 78(19)	2 82(26)	2 81(8)	2 91(8)	(61)

The numbers are pairs of ions/c c./sec in air of 1 atm pressure
The numbers within parentheses are numbers of records

A catalogue of 757 observations of auroræ boreales (1,134 noted auroral phenomena), carried out mainly at Abisko from the end of August 1932 to the end of March 1933, will be published elsewhere[3], and the catalogue contains also the simultaneously recorded values of the ionisation in the Steinke apparatus Some results of the comparison between simultaneous auroral observations and records of ionisation are briefly collected in Table 2, further results are found in the above mentioned catalogue

Table 2

Height of auroræ in the sky	Shield open upwards		Closed shield	
	Intensity of auroræ ≥ 0 5	≥ 2	Intensity of auroræ ≥ 0 5	≥ 2
0° N-60° N	2 783(174)	2 783(127)	1 944(63)	1 945(48)
60° N 60° S	2 780(78)	2 770(53)	1 942(33)	1 937(20)
60° S 0° S	2 774(59)	2 769(28)	1 933(16)	1 928(12)
During clear sky and no aurora	2 787(66)		1 956(56)	

The numbers are pairs of ions/c c /sec in air of 1 atm pressure
The numbers within parentheses are numbers of records N = North, S = South

As is seen in Table 2, the ionisation in 1932–33 *decreased* during auroræ and also with their extension to the southern horizon and with the intensity of the auroræ (scale: 0–4) It is curious that this decrease, expressed as a percentage of the ionisation with a clear sky and no aurora, is greatest when the vessel was shielded from above by a lead shield of 10 cm. thickness, that is, for the harder radiation

V. F Hess and R Steinmaurer[4] have found mainly a decrease of the ionisation during magnetic storms in the period September 1931–March 1933 from their records at Hafelekar, near Innsbruck Like the results from the second period at Abisko (great auroral displays being always accompanied by magnetic disturbances, which probably cause the change of the ionisation) this is in "apparent contradiction" to the results from the first period at Abisko Studying Table 4 of the exhaustive paper by R Steinmaurer and H. Graziadei[5], we find that in 1931 there were 4 increases and 1 decrease during 5 magnetic storms, but in 1932 there were 3 increases and 15 decreases during 18 magnetic storms. Thus the material from Hafelekar indicates a change from mainly increasing to mainly decreasing ionisation during magnetic storms in 1931–32.

At the present time, I cannot see any other explanation of the above mentioned "apparent contradiction" between 1929–30 and 1932–33 than that some connexion exists between the ionisation and the sunspot period The last sunspot maximum occurred at 1928 4, and the relative numbers for 1929 and 1930 were 65 0 and 35 7 respectively. For 1932 the relative number was 11 1, and the sunspot minimum occurred in 1933

The mechanism of the relation of terrestrial magnetism to cosmic ultra-radiation is still unknown, but as we now know no cause why the ultra-radiation should behave in opposite ways during magnetic storms at sunspot maxima and sunspot minima, it seems to me more probable that the cosmic ultra-radiation always decreases during magnetic storms, and that the observed increase of the ionisation in 1929–30 is caused by an increased influence from the sun at sunspot maxima This influence may be either an increased penetrating radiation from the sun itself, capable of reaching sea-level, or, possibly, an increased secondary radiation of the cosmic ultra-radiation, caused directly or indirectly by the solar corpuscles, which to some extent produce the auroræ.

Certain phenomena observed by other investigators[6] seem to support this explanation. Also the minor decrease of the ionisation for the open shield during magnetic storms at Abisko in 1932–33, mentioned above, may be due to a remaining primary or secondary soft radiation from the sun, tending to increase the ionisation.

AXEL CORLIN.

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Nov 17

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[1] Cf *Phys Z*, 31, 1065, 1930, and *Lund Obs Circ*, 1 and 6, 1931–32

[2] *Lund Obs Circ*, 1, 1931

[3] *Medd Lund Obs*, 2, No 67, 1934

[4] NATURE, 132, 601, Oct 14, 1933

[5] *Berlin Ber*, 22, 1933

[6] V F Hess, NATURE, 127, 10, Jan 3, 1931, and *Z Phys*, 71, 171, 1931 O Freytag, *Gerl Beitr*, 39, 1, 1933 E Regener, NATURE, 132, 696, Nov 4, 1933

Electrolytic Concentration of Diplogen

WE have recently made some preliminary investigations of the effect of various factors on the efficiency of the concentration of diplogen by electrolysis in alkaline solution The diplogen-hydrogen ratio at various stages was determined by specific gravity measurements after repeated distillation. These measurements were carried out in pyknometers of 5 c.c. and 25 c c. capacity with an estimated accuracy of one part in a hundred thousand. In calculating the diplogen concentrations, we have used Lewis's[1] value for the specific gravity of pure D_2O and Bleakney and Gould's[2] estimate of the D/H ratio in ordinary water.

We have investigated the influence of the following factors: (*a*) the nature of the cathode metal, (*b*) the concentration of the electrolyte, (*c*) the temperature of the electrolyte, and (*d*) the current density at the cathode. We have expressed the efficiency of the separation by the factor α, defined by Lewis and Macdonald[3] by means of the equation

$$d \ln D = \alpha\, d \ln H \qquad (1)$$

A correction was made for evaporation and the maximum error in our values of α is estimated to be $\pm$ 0.05. The following results were obtained:

Effect of Cathode Metal

Stage of concentration D/H 0.1–0.3 per cent

Cathode	Electrolyte	α
Ni	1 per cent NaOH	0.22
Pt	,,	0.19
Cu	,,	0.19

Effect of Concentration of Electrolyte

Stage of concentration D/H = 0.1–0.3 per cent

Cathode	Electrolyte	α
Ni	1 per cent NaOH	0.22
Ni	8 per cent NaOH	0.20

Effect of Temperature

Stage of concentration D/H 0.25–0.5 per cent

Cathode	Electrolyte	Temperature	α
Ni	2 per cent NaOH	10° C	0.23
Ni	2 per cent NaOH	100° C	0.26

Effect of Current Density

Stage of concentration D/H = 0.05–0.15 per cent

Cathode	Electrolyte	Current Density	α
Ni	1 per cent NaOH	10 amp./cm.^{2}	0.18
Ni	1 per cent NaOH	0.07 ,,	0.27

The most striking feature of these results is that the factor α is unexpectedly insensitive to the conditions of electrolysis. Neither the temperature nor the nature of the cathode metal appears to have any effect on the efficiency of separation, and it is doubtful whether the small difference observed in the current density experiments is greater than the experimental error.

It may appear strange that the efficiency is not affected by the differences in hydrogen over-voltage of the metals employed. Such a state of affairs is, however, in accordance with the theory of over-voltage advanced by Gurney[4]. He derives the following expression for the rate of discharge of hydrogen ions at an inert electrode:

$$\ln i_H = \frac{E_0 - E_1 + \epsilon V}{\gamma k T} + \log T + \text{constant} \qquad (2)$$

where i_H is the current density, E_0 is the neutralisation energy of an H_3O^+ ion in its lowest energy state by an electron, E_1 is the work function of the metal, ϵ is the electronic charge and V is the applied cathodic potential; γ is a correction factor a little greater than unity. The discharge of diplogen from the ion DH_2O^+ at the same cathode is governed by an exactly similar expression except that the value of E_0 will be different in the two cases. The nature of the cathode should therefore have no effect on the ratio i_D/i_H, in agreement with our results.

The actual value of i_D/i_H ($= \alpha$) is given by the relation

$$\ln \alpha = \ln \frac{i_D}{i_H} = \frac{(E_0)_D - (E_0)_H}{\gamma k T} \qquad (3)$$

The difference in the E_0 values in the two cases depends on the difference in zero point energy of the two links O–H and O–D, which has been calculated by Sherman and Eyring[5] as 1,400 calories per mole. The insertion of this value in equation (3) leads to our observed separation coefficient (which agrees with that found by Lewis[3]), if γ is given the plausible value of 1.4. It may be noted that on the basis of equation (3) the influence of temperature on α over the temperature range studied is just within our present experimental error, but could be observed with a slight increase in accuracy.

The above results are provisional, and more accurate investigations are in progress.

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[1] G. N. Lewis and R. T. Macdonald, *J. Amer. Chem. Soc.*, 55, 3057, 1933.
[2] W. Bleakney and A. J. Gould, *Phys. Rev.*, 44, 265; 1933.
[3] G. N. Lewis and R. T. Macdonald, *J. Chem. Phys.*, 1, 341; 1933.
[4] R. W. Gurney, *Proc. Roy. Soc.*, A, 134, 137; 1931.
[5] A. Sherman and H. Eyring, *J. Chem. Phys.*, 1, 345; 1933.

Catalytic Hydrogen Replacement and the Nature of Over-voltage

IN NATURE of December 16, 1933, J. Horiuti and M. Polanyi state that they have found that the replacement of heavy hydrogen in water under the catalytic influence of platinum black is faster in pure water than in either acid or alkaline solutions, and suggest that these observations "seem to settle the question" of the nature of the inertia which is responsible for the hydrogen over-voltage at platinum electrodes. There are, however, a number of other possibilities besides the two mentioned by Horiuti and Polanyi. I need only mention one, namely, that the effect of the acids and bases may be merely to cause a partial coagulation of the particles of the platinum, thus reducing the area available for the catalysis. Until such possibilities have been excluded, no definite conclusions as to the mechanism of the process can legitimately be drawn and it certainly appears to be extravagant to suggest that the experiments settle the question of the hydrogen over-voltage.

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Reaction Rates of the Hydrogen Isotopes

IT seems to be generally assumed that diplogen will always react more slowly than hydrogen. As I may partly be responsible for this view[1], I should like to point out that this is not always correct. Lower reactivity of diplogen compared with hydrogen results mainly from two causes: (1) the existence of zero point energy; and (2) the quantum mechanical leakage of particles through energy barriers. Whilst the leakage through the barrier is always greater for the hydrogen than for the diplogen atoms, the effect of the zero point energy may occasionally favour the reverse ratio. I will confine myself to one special case, as the general treatment will be published shortly by C. E. H. Bawn and G. Ogden. Compare the reaction of a free hydrogen and a diplogen atom; in the initial state the atoms possess no zero point energy and their energies will be equal. However, at the top of the barrier there will be a zero point energy present[2], and this will be greater for the complex reacting with the hydrogen atom than for that reacting with the diplogen atom The effect of the zero point energy at the top of the barrier is, therefore, to increase the activation energy of the hydrogen atoms to a greater extent than that of the diplogen atoms.

M POLANYI

Victoria University,
Manchester
Dec 18

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[1] Cremer and Polanyi, *Z phys Chem*, 19 B, 443, 1932 See also Eyring, *Proc Nat Acad Sci*, 19, 78, 1933

[2] Eyring and Polanyi, *Z phys Chem*, 12 B, 279, 1931

New Developments in *Gammarus chevreuxi*, Sexton

IN the course of some experiments on eye-colour in the amphipod, *Gammarus chevreuxi*, a number of mated pairs were brought in to the Laboratory from the Chelson Meadow salt-marsh between February 20 and March 13, 1933 Half the specimens were placed in an incubator, kept at an approximately constant temperature of 21° C and half were put in an unheated room

The F_1 from these pairs numbered 12,164

The normal eye in the wild *Gammarus* is a compound structure, composed of a number of ommatidia, each of which is provided with five retinular cells containing black pigment, the spaces between the ommatidia being filled with white 'accessory pigment' cells It is this pigment which gives to the eye of the living animal the effect as of a superficial white network spread over a black ground In the embryo eye, the retinular pigment commences as bright red, and darkens to black before extrusion

During the twenty years of our work on this species we have never found any but black eyed animals in the wild, nor have any changes in eye-structure or in colour appeared in the laboratory cultures before the F_3 generation Lately, however, we have come to the conclusion that the character of the wild stock is changing The conditions of its habitat have altered, owing probably to the installation of new sluice gates at the outlet from the salt-marsh These being operated at infrequent intervals have caused considerable variation in the depth, temperature and salinity of the water in the draining ditches where the *Gammarus* live, and are responsible for what is probably the most influential factor in the change, namely, the great fluctuations in the numbers of the population within comparatively short periods But whatever the causes may be, we have noticed in recent experiments that not only is there a much higher percentage of variation than formerly, but a much wider range as well

For the first time, we have had colour changes in the F_1 from the wild, and, for the first time also, a remarkable example of different coloured eyes in the same animal, one eye black and the other bright red Both instances came from a dredging taken on March 13.

The first, an ovigerous female, which hatched her eggs in the cold room a few days after being brought into the Laboratory, had evidently mated with a heterozygous male in the wild, for her brood when extruded contained 2 red-eyed young and 9 black-eyed. She was then mated with three different males from the same dredging, and gave an F_1 of 62 black with the first, 37 black with the second, and 34 black with the third, the red appearing in the F_2.

The second instance, the specimen with eyes of different colours, came from one of the pairs in the incubator. This pair produced three broods, the first numbering 13 black, and the third, 15 black, died without offspring The second brood consisted of 14 black and the one-sided red specimen just referred to, which had the right eye red Fourteen reached maturity, seven black males, six black females, and the one-sided red, a male The blacks, mated together, gave in some pairs an F_2 of black and red in a 3 1 ratio, and in others, all black offspring

The one sided red male's matings show that it behaves genetically as a heterozygous black It was mated with two of the heterozygous black females, giving 77 black and 22 red with one, and 25 black and 12 red with the other It was then tried with three of the F_2 red females and gave with the first 11 black and 10 red, with the second 10 black and 11 red, but with the third (which was from its own mating with one of the black females) the proportions were unexpected, 2 black and 20 red

Not one of the offspring of the one-sided red, nor of the thirteen blacks of its brood, has had eyes of different colours, either in the F_2 or the F_3, so far

With heterozygosity definitely proved to exist now in the wild stock, it seems strange that no red-eyed specimens have yet been found in the ditches Dredgings have been made throughout the year, and all the animals captured, 5015, examined for eye colour, but all without exception had the normal black eyes typical of the species

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Endocrine Factors in the Causation of the Creatinuria of Pregnancy

THE following points emerge from the experiments of Schrire and Zwarenstein[1]

1 Castration of male and female rabbits produces an increased excretion of creatinine In females the excretion of creatine is not affected

2 Injection of gonadal extracts reduces the high creatinine of castration to the pre castration level Injection of anterior pituitary extracts into normal animals produces an increased elimination of creatinine

3 The castration effect on creatinine is a secondary effect due to functional hypertrophy of the anterior lobe of the pituitary, which occurs as a result of gonadectomy

The experimental data are explicable on the following assumptions. The pituitary stimulates the formation of creatine. The transformation of creatine to creatinine in the muscles is controlled by the gonads in that they inhibit the formation of creatinine. In the gonadectomised animal, as a result of anterior pituitary hypertrophy, more creatine becomes available, and owing to the absence of the inhibitory activity of the gonads it is completely eliminated as creatinine

A typical case of acromegaly (male, aged forty-five years) investigated by Mirvish and Schrire[2] excreted 0 59 gm creatine, 2 58 gm. creatinine in 24 hours (average figures). The presence of creatine in large amounts, and the increased excretion of creatinine, can be explained as follows: Hypertrophy of the anterior pituitary leads (*a*) to increased formation of creatine and (*b*) to stimulation of the gonads. The latter factor increases the inhibitory action of the gonads on creatine–creatinine change with the result that some of the excess creatine appears in the urine as such, and some appears in the form of increased creatinine.

On the basis of the above considerations, the following hypothesis is advanced as an explanation of the creatinuria of pregnancy. Functional hypertrophy of the anterior lobe of the pituitary occurs in pregnancy, and this leads to essentially the same processes as in acromegaly except for the effect of a persistent corpus luteum. It is suggested that the corpus luteum reinforces the inhibitory action of the ovary on the transformation of creatine to creatinine so that all the excess creatine is excreted as such and the creatinine level remains unchanged.

Thus, in the castrated animal the inhibitory action of the gonads is nil, and all excess creatine is excreted as creatinine. In pregnancy the inhibitory action is a maximum, and all excess creatine is eliminated as such. Acromegaly presents an intermediate condition which leads to the appearance of creatine in the urine of males, and an increased excretion of creatinine. In all these conditions the hypertrophy of the anterior lobe of the pituitary, and the production of excess creatine, is a common factor, but the differences in urinary output are due to quantitative differences in the amount and extent of the inhibitory action of the gonads on the transformation of creatine to creatinine in the muscles.

It is possible that the endocrine factors outlined above, coupled with the probability that the immaturity of the young animal's muscles is associated with a defective capacity to utilise creatine (Powis and Raper[3]), may supply a basis for an explanation of the creatinuria during growth.

The hypothesis suggested rests only partly on experimental evidence but it indicates the lines on which future inquiry may profitably be based.

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[1] Schrire and Zwarenstein, *Biochem. J.*, 26, 118, 1932; 26, 1886, 1932; in press, 1932; in press, 1933.
[2] Mirvish and Schrire, Private communication 1933.
[3] Powis and Raper, *Biochem. J.*, 10, 363, 1916.

Experiments on Evaluation of Helium from Radioactive Minerals and Rocks

IT is very well known that the rate of loss of helium from different radioactive minerals and rocks depends on the dimensions of the surface and on the temperature. When minerals are finely ground, or heated to a high temperature, there is a considerable loss of helium, which can attain about 90 per cent when both of the above mentioned factors are concerned.

Theoretical considerations make it very probable that the amount of helium lost from minerals depends in some cases also on the composition of the gaseous phase which surrounds the mineral or the rock sample. We have proved this assumption experimentally and the results obtained seem of sufficient interest to be recorded.

The amount of helium evolved from different minerals at a given temperature, if this temperature is above a critical one, depends on the presence of hydrogen in the gaseous phase and is the greater the higher the partial pressure of hydrogen. The rate of loss of helium from uraninite (pitchblende) during two hours' heating at 500° is as follows:—*in vacuo*, 10 per cent.; in atmosphere of hydrogen at 25 mm. pressure, 17 per cent; in atmosphere of hydrogen at 100 mm. pressure, 36·5 per cent; in atmosphere of hydrogen at 500 mm. pressure, 60 per cent. The rate of loss from a mineral of the family of euxenite (chlopinite) at 900° is:—*in vacuo*, 13·3 per cent.; in atmosphere of hydrogen at 250 mm. pressure, 56·1 per cent.

The influence of hydrogen upon the rate of evolution of helium from minerals is so well marked that small amounts of hydrogen in a gas mixture can be detected by means of this process. A more detailed description of these experiments, and the discussion of the results obtained, will be given in another paper.

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Crystal Absorption by Substrates

IN the course of recent experiments it was found, in agreement with French[1], that suitable polishing destroys the crystalline structure of metallic surfaces. In addition, new and remarkable facts came to light. Thus, we have observed that when certain metal vapours are condensed on a substrate consisting of a polished metallic surface, crystals are formed which, however, rapidly disappear at room temperature. This is borne out by the fact that, whilst the freshly formed deposit gives rise to a characteristic electron-diffraction pattern, the rings more or less rapidly disappear, and that without any appreciable broadening effect. On the other hand, in the case of a crystalline but otherwise similar substrate, the diffraction pattern yielded by the deposit is permanent.

Thus, the stability or otherwise of the deposit crystals is determined by the condition of the substrate. For example, we have found that zinc vapour suitably condensed on a cool, polished copper surface gives rise to an initially brilliant and well-defined electron diffraction pattern which rapidly fades away, to become extinct within a few seconds. In one such experiment, twelve successive zinc layers were deposited. With each layer except the last the initial crystalline structure vanished at a rate decreasing with each successive deposit. Zinc deposited under otherwise similar conditions, but on sputtered or etched copper, or on a previously oxidised and then reduced copper surface, formed a crystalline film the structure of which remained unchanged. It seems to us that these facts afford direct experimental proof of the existence of the Beilby layer.

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[1] *Proc. Roy. Soc.*, A, 140, 637; 1933.

Observations of Water Trajectories in the Open Sea

DIRECT observations of continuous movements of water masses in the open sea do not appear to have been carried out before. We have, for this purpose, for some years been using free drifting current-crosses, followed by our research steamer the *Skagerak*. The crosses are made from two sheets of corrugated iron, intersecting at right angles, with the line of intersection vertical, and presenting an area to the current of approximately one square metre They are suspended from a cylindrical buoy of small dimensions drifting at the surface with its axis vertical. The buoy carries a very light rod projecting upwards with a small electric lamp at the top, of the type used by drifters for their nets. By varying the length of the thin wire rope by which the cross is suspended from the buoy, one may study the water movements in different depths, since the small resistance due to the surface buoy does not affect the movements of the cross to any large extent, so long as the current below is not too weak relatively to the surface current. The positions of the buoy are observed at intervals of an hour or less by bringing up the ship as close to the drifting system as possible, without interfering with its movements. In daytime, with moderately strong currents, the movements of the buoy are followed from the ship at anchor by means of a Zeiss tele-meter. Such drifting systems have occasionally been followed right across the Skagerak from Skagen to the lighthouse Måseskär on the Swedish coast

Last summer this method was found particularly useful for studies of the rotating currents discovered from the *Skagerak* in the central Baltic[1] In order to determine the shifting positions of the drifting system as accurately as possible far from the shores (lat 58° 01′ N, long 20° 30′ W), three large surface buoys carrying electric torches were anchored a few kilometres apart, by means of which the bearings of the ship following the drifting cross could be accurately found With the cross at 10 metres below the surface the trajectories from thirty hours' observations were found to form two beautifully smooth loops, showing, beside the rotatory current, a general displacement towards the S S W. The rotating vector turned by a little more than 720° in the same time The period thus is about fourteen hours, in good agreement with previous observations on these 'inertia currents' The details will be published in *Svenska Hydrografisk-Biologiska Kommissionens Skrifter*

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[1] NATURE, 131, 586, April 22, 1933

Ionospheric Investigations in Low Latitudes

DURING the recent expedition of the "Consiglio Nazionale delle Ricerche" in Eritrea for studying cosmic rays, I made many observations by the echo method on the state of the ionosphere at Asmara (lat 15° 20′ N, long 38° 55′ E), from September to November 1933 The most important results are as follows

The limiting wave-length for the vertical reflection in region *F* during the daylight hours reaches a minimum value between 26 and 28 metres towards six o'clock in the afternoon (local time) and not at noon as in the middle latitudes. In correspondence with this maximum of ionic density, waves between 140 m. and the limiting wave are reflected at heights which differ by less than 5 km.: this shows the formation of an extremely thin ionised layer

The most interesting phenomenon that has been revealed from these observations is that, toward two o'clock in the morning, a very strong decrease of the limiting wave-length in region *F* is frequently noted it may pass from 60 m to 40 m. (for the extraordinary ray) in an hour or two. Simultaneously, the virtual height of reflection decreases for all wave-lengths. After having shown this secondary nightly maximum, the ionic density decreases until about half an hour before sunrise, and then increases again during daylight Another striking feature of the ionospheric conditions is the violent fading and complexity of echoes which accompany these nightly increases of ionic density. On many occasions I have observed the simultaneous rising of a particular type of atmospherics with continuous rustling

Region *E* presents a maximum of ionic density, which is always less than that of region *F*, and it is also sometimes subject to nightly increases of ionic density, chiefly in the early hours of night

The observed phenomena, especially the nightly increases of ionic density in region *F* and the occurrence of the daily maximum about six hours after the sun's radiation reaches its maximum, having regard to the geomagnetic latitude of Asmara (11° 30′), cannot be explained as due to electrified corpuscles from the sun or other cosmic origin, which may be able to ionise the high atmosphere At present, the only logical suggestion which can be formulated is C T R Wilson's[1] that the effects are due to the ionisation produced by the electric fields of thunderstorms, which undoubtedly reach very high values in tropical regions

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[1] *Proc Phys Soc*, 37, 320, 1925 *Proc Roy Soc*, A, 141, 706, 1933

Vibrational Energy Levels of Hydrogen Cyanide

THE infra red spectrum of HCN vapour has been examined with fairly high dispersion in the region near 2μ The following bands were observed.

Band	Position	Character
$\nu_2 + \nu_3$	4005 6 cm^{-1}	perpendicular
$\nu_2 + 2\nu_1$	4993 9	perpendicular
$\nu_1 + \nu_3$	5405 0	parallel
$2\nu_3$	6523 5	parallel

The band at 5405 is somewhat distorted, due to water vapour absorption in the same region, and its position is accurate only to within a few wave numbers The discovery of the two perpendicular bands makes it possible to construct the complete vibrational energy level diagram of the normal molecule with a high degree of precision. In a report to appear in the near future the detailed analysis will be presented, and also the application of the results to the determination of the thermodynamic potentials of hydrogen cyanide.

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Research Items

Polychrome Jewellery in Kent A new view of the origin and dating of the garnet-inlaid jewellery from Teutonic graves in Kent is put forward by Mr T D Kendrick in *Antiquity* for December According to the generally accepted view of the two groups into which this jewellery falls, one (Style *A*) characterised by cloisonné and filigree, in which there is no chip-carving and niello is rare, is regarded as later than the class (Style *B*) in which chip-carving and cast settings are the rule, niello is common, and there is no filigree and no cloisonné The earlier, Style *B*, is dated as from the early sixth century, while Style *A* is assigned to late sixth or early seventh century, one view holding that the latter represents Jutish supremacy under Ethelbert It is here suggested, however, that a substantial part of the polychrome jewellery belongs to an earlier Kentish population than the Jutes of Ethelbert, and that the two groups are contemporary and belong to the archæology of the Jutish invasion, with a central date at about A D 500 It is clear that Style *A* had a cultural background of its own, remarkable for its 'luxury' or foreign aspect, being associated with Coptic bronze bowls, amethyst beads and cowries It is also associated with 'British' hanging bowls Its distribution in the main is along Watling Street, while Style *B* is found chiefly in Thanet and the Sandwich country While Style *B* may well be Jutish, it is suggested that Style *A*, which exhibits unrivalled workmanship and is clearly a distinct culture, was of British origin The distribution of the two cultures is explicable on the supposition that for a time the Dover road continued to be held by British when all other lines of communication had been blocked by the Jutes and that the Teutonic settlements along the Watling Street are those not of Jutes but of miscellaneous Teutonic mercenaries called in to help keep open communications with the Continent

Rain-making in Neolithic Times Prof. L Joleaud (*Revue Scientifique*, Nov 25) constructs a pedigree for certain rites connected with rain and the supply of water in rivers, lakes and wells in north-west Africa, which extends back to neolithic times, through references in classical authors, analogies from Ancient Egypt and the rock drawings of North Africa, more particularly in Morocco and the Sahara The essential feature in the modern rites is a procession of domestic animals, especially rams and oxen, accompanied by men bearing ladles and spades and sometimes playing ball with sticks, hand or foot The beasts are decked with various ornaments and trappings, feathers, leaves, amulets, etc Both animals and men participating should urinate in the course of the ceremony and special honour is paid to the genital organs of both men and beasts. The rock-drawings of Oran, and to a less extent of the Sahara, bear witness to the neolithic origin of these rites Rams and oxen, similarly caparisoned, are shown in the drawings taking a prominent part in invocation rites In some instances, what would appear to be intended for rain is falling on the animals. Sometimes men or beasts are shown urinating or preparing to perform that act. In a cave at Cape Spartel in northern Morocco a large number of terra-cotta models of neolithic date of the genital organ of rams and bucks have been found, which, apparently, had served as idols or *ex-votos* The place of the ram, which is the most prominent animal in the neolithic rites, is taken later, at about the period of the æneolithic age in Egypt, by the bull Prof Joleaud traces the connexion of these early animal figures with animal-headed gods such as Ammon and their development into anthropomorphs

Mammals of California Dr Joseph Grinnell has compiled a catalogue of the recent mammal fauna of California in which he indicates the place of the original description, the type locality and the range of 460 species and sub-species, including four sub-species of man (Univ California Pub Zool., 40, No 2, 71-234, 1933) This number of distinct forms, which includes 220 full species, has greatly increased since the first Californian list, of 1868, with its 115 kinds, or even the 1906 list of Frank Stephens, with 276 kinds The list includes several species of non-native mammals such as the black and Norway rats, the Alexandrine rat and the house-mouse, only the first of which is relatively scarce and is confined to coast-wise cities. Equally successful in its powers of colonisation has been the Virginian opossum, first introduced by man probably about the beginning of the present century and now present in nearly all the counties of San Francisco Bay region and of the Pacific slope of Southern California

Territory in the Life of Birds The theory of territory in bird life, enunciated by Eliot Howard some twenty-five years ago and supported by the field observations of himself and others, has never gained complete acceptance, and now David and Dr Lambert Lack have formulated a reasoned argument against the wholesale application of the theory (*British Birds*, 179; Dec. 1933) Were territory a primary requirement for success in reproduction, it might be expected to be universal amongst birds. It is not universal, and many of the most successful amongst birds are colonial breeders Moreover, according to the authors, there is no good evidence that territory is important in conserving a food supply for the young Many territorial birds, like colonial birds, obtain their food, not from their own 'territory', but from a common feeding ground; they allow other members of the same species to feed in their territory; and, on occasion, even their own selected females may ignore the territory of their mate and build in that of another male. Indeed 'territory' is really nothing more than a male bird's song centre, in which he can sing and display in prominence, and since these activities are at their highest at the beginning of the breeding season, it is only at that period that territory is strictly maintained

Russian Spiders. A list of the spiders of the U.S S R., prepared by Prof D Charitonov, has just been published by the Leningrad Academy of Sciences (Katalog Russkich Paulov, *Ann Mus. Zool*, 32, 1-206) The classification adopted is that of Petrunkevitch (1928) and the list includes the names of 1,068 spiders found in Russia, with the localities and captors of each species The introduction and notes are printed in Russian and German. All records to

1930 are included, but many districts are still unsearched and a large increase may be expected. Of the 222 genera mentioned, 163 are also British, so that the work supplies a welcome addition to our knowledge of the range of many British species. It appears that more than half the Russian spider fauna belongs to four families—Linyphiidæ 261, Lycosidæ 145, Attidæ 127 and Thomisidæ 110 species, the corresponding British figures being approximately 240, 36, 33 and 34. Before long, Great Britain will be the only European country in which a recent list of the native Araneæ is not existent, a fact which should be remedied.

Biology of *Calanus*. In a contribution to the literature of *Calanus*, Dr. Sydney G. Gibbons gives an account of material collected in a restricted part of the North Sea ("A Study of the Biology of *Calanus finmarchicus* in the North-Western North Sea" Fishery Board for Scotland Scientific Investigations 1933 No. 1). Of all the copepods caught in the nets, *Calanus* predominates to a large extent in almost every haul, at certain times (May–August) the mean percentage abundance reaching 70 or more. Special attention is given to the separate stages picked out from the plankton, from nauplius to adult—eleven stages in all. The author is able to show that from the last larval stage (fifth copepodid stage), which shows no trace of external sexual characters, the perfect male or female arises. Besides this he has found a sixth nauplius stage, not before noticed, coming between the fifth nauplius and the first copepodid stages. The area investigated is difficult to compare with other regions where *Calanus* has been specially worked out. There is a very small winter population which in November consists of slowly developing late copepodid stages. By February many have grown into adults which breed, and nauplii appear. A rapid rise in numbers in April is due in the north to additions from outside, in the south from breeding of adults already there. Soon the southern section is inundated with 3rd and 4th copepodid stages from outside. The influx first affects the north, then the south, and the *Calanus* population is due both to movement from north to south and to development within the area.

Polyhedral Cells. F. T. Lewis has recently discussed the shapes of cells (*Proc. Amer. Acad. Arts and Sci.*, 68, June 1933), in the investigation of which he has employed the wax-plate reconstruction method. He states that tissues are not composed of rhombic dodecahedral cells, truncated or otherwise, for these shapes have characteristic tetrahedral angles which cells avoid. In a mass of cells of approximately uniform size, the average cell has fourteen faces of contact with its neighbours; it is a tetrakaidecahedron. Data in support of this are given for 100 cells in elder pith and in fat tissue and for 50 cells in precartilage in the tadpole of *Bufo*. In the elder pith the cells tend to be in orderly arrangement in columns, but in fat and precartilage the cells, with the same number of facets, seem piled in lawless confusion. A reconstruction shows 16 cartilage cells, with an average of 14.1 facets, which had 12–21 facets each. The author adds a surmise concerning nerve cells and neuroglia, pointing out that these two types of branching cells arise out of the primitively uniform cells of the medullary tube. Since cells formed around nuclei distributed at random are on the average 14-hedral, it may be assumed that the primitive cells of the medullary tube are of this character. He suggests that the nerve cells imbibe, grow and send out processes; the neuroglia cells become relatively shrunken. The processes of the nerve cells, one axone and the dendrites, would grow, out along the lines of least resistance, extending from the corners of the cells as shown in a model, but with the regression of the neuroglia the intracellular spaces would become large and the dendrites would not preserve their angular kinks.

Primulas in Bhutan. A very interesting account of a botanical tour in Bhutan, a State between India and Tibet, appears in No. 87 (vol. 18) of *Notes from the Royal Botanic Garden, Edinburgh* ("Botanical Tours in Bhutan, with Special Reference to the Occurrence of the Genus *Primula*", by Roland Edgar Cooper, pp. 67–118, Nov. 1933). The author visited Bhutan in 1914–15, touring the country extensively. Notes of the general distribution of vegetation are given, but the various members of the genus *Primula* received special attention. Several new species or forms are described in the paper under review, and seventeen out of the thirty-two sections of the botanical genus occur in Bhutan. The species are all described according to the classification of Smith and Forrest (1928), and are extremely useful in providing information about the natural habitats of many garden primulas.

Fungi causing Sooty Moulds. Several European mycologists have, in time past, described various fungi which produce a black, powdery mould upon the leaves of various plants. The idea that this condition was due to infection by two or more fungi had been growing, but proof is now forthcoming ("The 'Sooty Moulds' of some Australian Plants", by Miss E. E. Fisher, *Proc. Roy. Soc. Victoria*, 45, N.S., Pt. 2, 1933, pp. 171–203). Sooty moulds on plants of *Bursaria spinosa*, *Leptospermum* spp., *Myoporum insulare* and *Melaleuca* sp. have been investigated. On some hosts the mould consists of two fungi, but usually there are three types: a perithecial stage, which is often a species of the genus *Teichospora*, a pycnidial stage, and an open conidial stage. The fungi of each stage which appear upon the hosts mentioned above are described in minute detail, both as they occur in Nature and as they behave upon culture media.

Observations on a Tropical Cyclone. The *Marine Observer* of October 1933 contains an account of a particularly violent hurricane through which the S.S. *Phemius* passed on November 5–9, 1932, when on a voyage from Savannah to Colon. The description is by the observing officer, Mr. H. Nicholas. It does much to correct the impression of symmetry and simplicity sometimes conveyed by accounts of tropical cyclones in meteorological textbooks. Four barometric minima were experienced, and on one day—November 6—two lulls with phenomena characteristic of the calm 'eye' of a storm were experienced at about 2 a.m. and 4 p.m., each of which lasted about an hour. The *Phemius* lost her funnel and had derricks, lifeboats and bridges wrecked by the force of the wind, the speed of which was estimated as two hundred miles an hour, and for a long time the ship was carried by the storm in an unmanageable state. The lowest barometric minimum occurred at

8 p.m. on November 5, this being the first of the four minima, which followed a continuous and very rapid fall of pressure. The reading fell to 914.6 millibars (27.01 in.), which is 4.3 millibars (0.13 in.) lower than the previous lowest verified barometer reading recorded in a tropical cyclone, namely, in the hurricane of September 19, 1885, which passed over False Point, River Hooghly. The ship's barometer, it may be noted, had only recently been supplied by the Meteorological Office, and had been certified by the National Physical Laboratory during the previous year. On emerging into fair weather, the *Phemius* was taken in tow by a salvage steamer, and the hurricane continued northwards to cause much damage on Grand Cayman Island.

Pipe Heaters and Coolers. The report by Dr. Ezer Griffiths and Mr. J. H. Awbery on the measurements they have made at the National Physical Laboratory under the auspices of the Engineering Committee of the Food Investigation Board on the heat transfer between metal pipes and a stream of air was read by the authors before the Institution of Mechanical Engineers on December 15. It supplies more definite information than has been available hitherto on the effects of the speed and temperature of the air, the size and temperature of the pipe and its position with respect to neighbouring pipes, on the interchange of heat between air and pipe. For dry pipes the interchange is the same for the same two temperatures whether the pipe is hotter or colder than the air. If ice or snow form on a cold pipe but remain dry, the abstraction of heat from the air is the same as from a bare pipe of the diameter and temperature of the outer surface of the covering, but if water is dripping from the ice or snow the heat abstracted is increased 30 per cent. In all cases turbulence in the air stream increases the heat interchange.

Background Noise in Amplifiers. It has long been recognised that some of the background noise in valve amplifiers is due to the inherent properties of materials as they exist. In a paper read to the Institution of Electrical Engineers on December 6 by E. B. Moullin and H. D. M. Ellis, the causes that give rise to the noise are divided into two classes. There is first the spontaneous voltage in the circuit called 'thermal agitation', and there is secondly the inherent mechanism of thermionic conduction within a valve which is called the Schrott effect. The experimental work described in this paper is a continuation and amplification of the pioneer work done by other scientific workers. All the component portions of an amplifier produce spontaneous fluctuations of voltage and those harmonic components which are inside the acoustic range disclose themselves by making background noise. This noise is always a scratchy hissing noise, but the general level of the pitch rises with the frequency of the circuit. The experimental results given verify the theory. It is shown that bare wire is unsuitable for use in the early stages of a high magnification amplifier as it exhibits curious effects when it carries a current. The electric current passing from the filament to the anode of a thermionic valve is now considered to be a stream of individual electrons. The pattering of these electrons on the anode maintain it at a fluctuating potential. Since these electrons come to rest in the space charge at random intervals of time, they arrive at irregular times and so participate in the general Schrott effect. According to the authors' view, the Schrott voltage is due essentially to the anode circuit receiving current by discrete charges, and must always occur.

Collisions of Neutrons with Atomic Nuclei. Feather (*Proc. Roy. Soc.*, A, Nov.) has carried out further cloud chamber investigations on the collisions of neutrons with light atomic nuclei. The neutrons were derived from a polonium-beryllium source and the tracks were studied in oxygen, an oxygen-hydrogen mixture and a mixture of acetylene and helium chosen to have suitable properties for the working of the expansion chamber. A frequency curve of the ranges of the oxygen recoil atoms is similar to the curve for nitrogen collisions, obtained from previous work and presented here in a revised form. Few oxygen recoil atoms have a range greater than about 2.8 mm. of air. Using data of Blackett and Lees to correlate range of recoil atom with velocity and assuming that the collisions of the neutron are elastic, most of the neutrons are found to have an upper energy limit of about 4.5×10^6 volts. It is not clear whether the neutrons form a homogeneous group or a continuous distribution, since the distribution curves of the recoil atom energies are in any case continuous. The interpretation of the tracks obtained in the mixtures is complicated. The distribution curve for the acetylene-helium mixture shows a pronounced change in slope at 46 mm. range; this may be ascribed to helium or to carbon. In the former case, it would indicate the appearance of a group of neutrons of energy about 1.1 million volts—presumably produced by resonance disintegration, and in the latter case it would indicate the presence of neutrons of more than 10 million volts. The study of the brightness variation of several individual tracks indicates that they ought to be ascribed to carbon nuclei, and gives some evidence in favour of the existence of high velocity neutrons. In addition to the elastic collisions, disintegrations were observed in oxygen, and ascribed to the capture process $O^{16} + n \rightarrow C^{13} + He$, the energy relations requiring the production of a high energy γ-ray. The disintegration of carbon is very rare, if existent, only one case being found in more than two thousand photographs.

Temperature Data of Metals. Sir Robert Hadfield and the Research Department of his firm, Messrs. Hadfields, Ltd., Sheffield, have recently published a new edition of a temperature chart extending from −273.05° C. up to the temperature of the electric arc, which they give as 3,700° C. (T 6165. 1s.). The melting and boiling points of various materials are tabulated, the greatest care having been taken to ascertain the latest and most reliable data. An interesting, and unusual, feature of this chart is that the degree of accuracy with which the temperature is known in any particular case is indicated by the manner of its presentation. Thus, up to a temperature corresponding with the melting point of copper, 1083.0° C., the temperature is regarded as being reliable to within ±0.1° C., whilst at the melting point of molybdenum, 2615° C., the degree of accuracy is regarded as ± 5° C. In addition to the data for the pure results, the melting points of various refractory materials, the temper colours of steel and other industrial temperatures of importance, are recorded. The purpose of the chart is stated to be: "To present to those concerned, in convenient form, various temperature data of general interest", and in this the producers are singularly successful.

Reference Chart for the Apparent Motions of the Sun, Moon and Planets

By DR. B. K VAIDYA, Indian Institute of Science, Bangalore

THE apparent motions of the sun, the moon and the planets during the course of a year can be represented very conveniently by plotting on a single sheet of paper the right ascension of these bodies corresponding with each day of the year The planetary chart prepared in this way gives a picture of the sky for the whole year, so far as the principal members of the solar system are concerned, and besides, it shows at a glance all the planetary phenomena and the days when they occur

Fig 1 shows such a chart for the year 1934 It is not possible to include in the diagram the variations in the declinations of the objects, but this need cause little interference, as the movements considered here lie within the comparatively narrow region around the ecliptic Along with the right ascension hours on the ordinate are given the names of twelve stars in the zodiacal constellations. These stars are placed at a distance of approximately two-hour angles in succession, and lie at points which are very near the ecliptic. They serve to locate the positions of the planets, the sun and the moon at any desired day of the year.

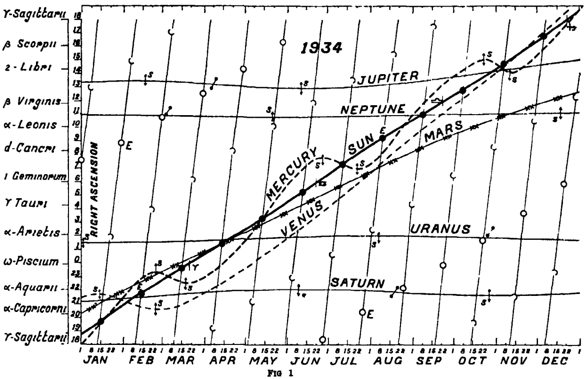

FIG 1

The most interesting types of curves are described by the two inferior planets, Mercury and Venus Their motions lie alternately above (eastern elongation) and below (western elongation) the sun's line of motion, corresponding to the periods when they appear as the evening and morning stars, respectively The greatest elongations are reached on the days when their distances from the sun line are a maximum. When their paths intersect the sun line during a forward motion they are in superior conjunction with the sun, while during a downward or retrograde course they pass through an inferior conjunction at the point of intersection with the sun line The proper dates and periods for these and other phenomena are read off on the abscissa

In other respects the chart is self-explanatory. The dates for the mutual conjunctions of the planets and for their conjunctions with the sun and the moon are given by various points of intersections The stationary points at the two extremities of a retrograde path are marked *S* The time of opposition to the sun is marked by the appropriate symbol. The moon's path, with the four principal phases, is shown by a number of slanting lines crossing the whole of the diagram The solar and the lunar eclipses are marked by the letter *E* near a new moon or a full moon. The times of the equinoxes and the solstices are indicated by the conventional zodiacal symbols.

The time of the rising or the setting of a planet on any particular day may be ascertained by finding its distance from the sun on the day in question. This distance gives directly the duration in hours for which the planet would be visible above the horizon, after the sunset or before the sunrise according to its position above or below the sun line. Thus it may be seen from the diagram that at the end of January 1934 a remarkable phenomenon occurs when the sun is closely followed by the four planets, Mercury, Venus, Saturn and Mars, the first three of these setting about half an hour and the last about an hour after the sun.

Disorientation and Vertigo

SECTIONS I (Physiology) and J (Psychology) of the British Association discussed on September 7 at a joint meeting the problems of disorientation and vertigo. Dr. J. T. MacCurdy (Cambridge) was the first speaker. He said that the most universal type of physiological orientation is the reaction to gravity. When the effective value of g is varied, there is an increase or decrease in the tension of the muscles which withstand the drag. When the direction of g is changed, there are reflex movements of the trunks and limbs which re-orient the body to g, the so-called righting reflexes. Any disturbance of these balancing reactions would upset the bodily orientation, if there were no accessory means of judging the direction of g. Such a means exists in vision.

The labyrinthine sensations, regarded generally as the most important for maintaining posture, are regarded by MacCurdy, following Garten, as the least important, and the muscle and deep pressure senses as the most important factors.

Discussing the relationship of vertigo to disorientation, Dr. MacCurdy pointed out that when the labyrinth or other parts of the balancing system are diseased, the body is physiologically disoriented, but the individual is not necessarily psychologically disoriented, if his judgment remains intact. His judgment, however, can be interfered with in three ways: either his attention may be distracted by giddiness or by his efforts to maintain his balance; or objects themselves may be viewed with difficulty because they are in motion or seen at an unfamiliar angle; or the posture-balance component of the visual perception may be absent or distorted. All these conditions involve for compensation the intellectual building up of a correct perception, which may be substituted for the usual, automatically correct reaction to g.

Dr. MacCurdy illustrated his points from the sphere of flying, and further illustrations were given by Flight-Lieutenant Haslam, R.A.F.

In his final remarks, MacCurdy discussed nausea and vomiting and formulated a theory as to its physiological mechanism. Two types of sensitiveness probably exist, he suggested, one due to violent changes in the value of g, the other due to changes in the direction of g. The normal response to increase of g is tension in the extensors and rigidity of the abdominal walls. If this is ineffective, a diaphragmatic tug ensues. Dr. T. G. Maitland (Cunard Steamship Co., Ltd.) agreed that the diaphragmatic pull is important, but only as an auxiliary cause of nausea.

Dr. Maitland pointed out that the vestibule and the semi-circular canals are the chief receptors of imposed movement. They have been evolved to meet only certain modes of such movement. When they encounter movements of another order, the reflexes they evoke not only fail to maintain equilibrium, but also actually disturb it. The sensory receptors of the muscles, tendons and joints, and the skin of the supporting structures, are excited by these reflexes. These muscles give a false orientation and so vertigo is caused which is an 'emotive and hallucinatory reaction'. Vertigo, of course, may also arise from other causes.

It is not certain what part the semicircular canals, primarily receptors for rotatory movement, play in rectilinear movement, though both rotatory and rectilinear movements excite vertigo. Although evidence from experiments is conflicting, various facts suggest that rectilinear movements do affect the semi-circular canals, but not when the deviation is slight. Dr. Maitland also directed attention to the fact that the conditions of the vertigo excited by descending rectilinear movement are the reverse of those of the vertigo excited by angular rotatory movement. In the former case, the vertigo is pronounced at the inception of the movement, reaches its maximum with acceleration, diminishes with retardation, and disappears with cessation; whereas in the latter case, it is absent at the inception or acceleration of the movement, slight with retardation, and maximal with cessation.

Squadron-Leader E. D. Dickson, R.A.F., remarked that controversy has raged over the part played in flying by the vestibular apparatus, and that played by deep sensibility and eyesight in appreciating the position and movement of the aeroplane in space. In movements such as loops, spins, nose-dives, etc., the manœuvre is undoubtedly appreciated by the nerve endings in the semi-circular canals and to some extent by the otoliths, but this does not mean that consciousness is necessarily involved. In movements concerned with inclinations round a sagittal axis, such as in banking, or rising or descending, it is difficult to determine what part is played by the labyrinth and deep sensibility, and what part is played by perception of the position of the aeroplane in space. He then proceeded to discuss in detail the various evolutions practised in flying and to analyse very carefully the salient features in each. His general conclusions were: (1) the labyrinth plays no definite rôle in orientation so far as flying is concerned; (2) sight is the most important factor in informing us of our position in space; (3) in the absence of sight, deep sensibility is next in importance.

Mr. R. J. Bartlett (King's College, London) took up the position that probably one immediate physiological cause of disorientation and vertigo is insufficiency of available oxygen in the blood supply to the brain. Faulty breathing may, therefore, be a causative factor. In air and water travel, a principal cause of the faulty breathing may be the bodily reactions to the changing incidence of the pull of gravity with the rolling or pitching of boat or aeroplane. Bartlett finds that the effects of land and ocean travel can be induced in suitable subjects by vibration without any rolling, pitching or translatory movement. The subject sits in a chair attached to a box containing a motor loaded eccentrically and run at speeds from twelve to twenty revolutions per second. Changes in the frequency of the vibration and certain critical frequencies are found to be particularly effective; pneumograph records show the marked effect on the breathing of susceptible subjects. When it is difficult or impossible to keep the vibration and the breathing in harmony, discomfort is experienced.

Dr. R. S. Creed (Oxford) stated that in vertigo there must be: (1) false sensations of movement, or perhaps sometimes only of position; (2) a tendency to make compensatory movements jeopardising balance; and (3) consciousness of the falsity of the sensations, causing a feeling of uncertainty and unsafeness whence arises mental confusion and distress. The first two of these may occur alone, resulting in some degree of disorientation, and the subject may fall to the ground, but without any of the unpleasant feelings associated with the word giddiness.

In people who are particularly susceptible, vertigo accompanied even by nausea and vomiting may easily be brought about by kinæsthetic impulses or by moving visual stimuli But that the labyrinth is by far the most usual and important sense organ from which vertigo is aroused, and probably the only one concerned in sea-sickness, is now firmly established. James, Kreidl and Mygind have all commented on the immunity from sea-sickness of deaf-mutes in whom the labyrinths were deficient The experiments of Dreyfuss on guinea-pigs and of Kreidl on dogs, cats and pigeons pointed in the same direction Decerebration, decerebellation, or section of both vagi leaves sea-sickness unaffected, but removal of both labyrinths or section of both eighth nerves results in complete immunity The most likely explanation of the vomiting seems to be that it is caused by spread of excitation from the vestibular nuclei to the neighbouring medullary 'vomiting centre'.

As a result of the interest aroused in the discussion, a joint research committee of the Sections of Physiology and Psychology has been set up to investigate the conditions of vertigo and its relation to disorientation

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Fishes of Mountain Streams

DR SUNDER LAL HORA, of the Zoological Survey of India, has for many years devoted special attention to the study of the fauna of rapidly running waters in the hill streams of India. His knowledge of this difficult and interesting branch of zoology is unrivalled No one, therefore, could be better qualified than he to undertake a detailed investigation[*] of that remarkable group of cyprinoid fishes, the Homalopteridæ These fishes, inhabitants of swiftly running mountain streams of southern Asia, have undergone a great variety of adaptive modifications induced by the peculiar environmental conditions typical of their habitat

In the first part of his report the author deals with the taxonomy of the group It is divided into 2 sub-families—the Homalopterinæ, comprising 6 genera and 31 species, and the Gastromyzoninæ which is represented by 11 genera having in all about 16 species In the Homalopterinæ 4 new species belonging to the genera *Homaloptera* and *Lepturichthys*, and 2 new varieties of *Balitora brucei* are described Among the Gastromyzoninæ no new species have been found, but in order properly to classify the existing species 5 new genera are proposed in this paper. No attempt has been made to describe in full each and every species, but wherever an amplification of the already existing description seemed to the author to be desirable the species is either redescribed or a note is inserted concerning some of its most important features

In the second part of the paper the bionomics and evolution of the Homalopteridæ are discussed at some length. The most characteristic features of its members such as flattened shape, insertion of the pectoral fins (which are used for adhesion) far forward below or even in front of the eyes, possession of a peculiar rostral groove in front of and continued along each side of the mouth, the peculiar structure of the hard and strong lower jaw, are shown to be definitely correlated with the three most important factors in the environment—strong current, high oxygen content, and nature of the food supply available. Throughout the paper attention is repeatedly directed to the 'communal convergence' that is exhibited by these fishes and to the series of characters showing parallel development in the members of the two sub-families From all the evidence which he has acquired the author believes that the Homalopteridæ are probably a polyphyletic family the members of which are derived from the Cyprinidæ and Cobitidæ and have come to resemble one another superficially under the influence of the same environmental conditions

Dr Hora is to be congratulated on having produced a paper which is not only a valuable addition to the literature on the taxonomy of the Homalopteridæ but is also of great theoretical interest.

G. A. S.

[*] *Memoirs of the Indian Museum*, vol 12, No 2, pp 263–330 "Classification, Bionomics and Evolution of Homalopterid Fishes". By Sunder Lal Hora Calcutta, December, 1932

Geological Reconnaissance by Aeroplane in Australia[*]

IN 1932 the Royal Australian Air Force made flights over many of those areas in Australia which are deemed to be worthy of investigation from the point of view of the discovery of oil Dr W. G. Woolnough, who was present as observer and geologist, has now detailed the results obtained in a report which gives valuable information regarding the function and importance of aerial work in assisting and expediting geological survey. The object was to determine the disposition of strata and especially to locate dome structures, the investigation being made partly by visual observation and partly by the study of the photographs taken from the air Much experience is required before the utmost can be achieved by these methods, and Dr Woolnough states that he scarcely began to appreciate the significance of details seen from above until he had completed one hundred hours of flying.

From July until September, a circuit of Australia was made—also a visit to Tasmania, atmospheric conditions on the whole being favourable Over Melville Island observation was hindered by a tribal fight, as part of the strategy consisted in the lighting of extensive bush fires, the smoke of which provided nuclei for the condensation of moisture and the development of clouds The orientation of the photographs and the elevation of hills and scarps above the surrounding country can be determined by noting the direction and lengths of shadows—provided the time of exposure is accurately known.

In those regions where the rocks are well exposed and where topographical forms are the direct result of the differential erosion of beds, the main tectonic features are easily seen, and examination of the photographs reveals where the detailed ground investigation, which is essential to the full elucidation of the structure should be undertaken. Most valuable is the clearness with which the true disposition and

[*] Commonwealth of Australia. Report on Aerial Survey Operations in Australia during 1932. By Dr. W. G. Woolnough (Canberra Government Printers)

continuity of strata can be made out from the bird's-eye view of country in which the ground worker is baffled at close quarters by the confusion of detail resulting from erosion, accumulations of detritus, and the presence of false dips due to local and superficial collapse of strata. The observer is warned against reading 'strike' into a banding due to the parallel alignment of superficial sand dune accumulations; furthermore, where dips are slight, it is often impossible to determine in which of the two possible directions they lie, and for this ground-levelling is required.

It was in bare featureless plains devoid of rock exposures that the most remarkable results were obtained. Sometimes it was possible to detect geological structures of great importance where the absence of outcrops presents an insurmountable obstacle to ground survey. Here a pattern can be discerned which the geologist can recognise at once as that of a geological map, and in one case the proved structure of an area with abundant outcrops was followed into adjacent lowlands the geological structure of which has hitherto remained hidden. Such pattern is due to the different appearances of soils to the 'actinic eye' of the camera. Clearly these soils have developed from the weathering of the rocks beneath them, the disposition of which they thus reveal. Pattern may be seen through thin parched grass but it is lost with a fresh luxuriant growth, and the survey must be made when the conditions are favourable.

Some success was achieved in gleaning information regarding the geology of heavily forested regions, and much may be expected from the further development of this line of attack on a type of country which is the despair of the investigator on the ground.

L. H.

University and Educational Intelligence

LONDON.—The following appointments to University readerships have recently been made: botany (Birkbeck College), Dr. F. C. Steward, since 1929 assistant lecturer in botany in the University of Leeds; epidemiology and vital statistics (London School of Hygiene and Tropical Medicine), Dr. A. B. Hill, who since 1923 has been carrying out investigations and research at the School.

The title of emeritus professor of eugenics in the University has been conferred on Prof. Karl Pearson, on his retirement from the Galton chair of eugenics at University College, and that of emeritus professor of Egyptology in the University on Sir Flinders Petrie, on his retirement from the Edwards chair of Egyptology at University College.

The following degrees have been awarded: D.Sc. to B. F. Barnes (Birkbeck College) for ten published works on botany; D.Sc. to J. C. F. Hopkins (King's College) for ten published works on plant pathology.

MR. THURKILL COOKE, a member of the General Committee of the British Association, has offered to present to the universities of England a collection of works on nautical science. The first presentation under the offer has been made to the University of London. Librarians of English universities desirous of receiving such accessions should communicate with the Assistant Librarian, British Library of Political Science, Houghton Street, W.C.2.

Science News a Century Ago

Royal Society, January 9

The portrait of the late president, Davies Gilbert, painted by Thomas Phillips, R.A., at the solicitation of several members, was, by their request, presented to the Society. A paper was read on 'The Empirical Laws of the Tides in the Port of London'. By the Rev. William Whewell, F.R.S., Trinity College, Cambridge. The author regards existing tide tables as extremely imperfect; the mathematical solutions of the problem founded on hypotheses remote from the real facts. The Earl of Tyrconnel was elected into the Society.

The Royal Medals of the Royal Society

The January issue of the *Gentleman's Magazine* in 1834 contained an excellent notice of the anniversary meeting of the Royal Society. The Duke of Sussex made a statement relative to the Royal medals placed at the disposal of the Society by His late Majesty in 1828. Mr. Chantrey, in conjunction with Sir Thomas Lawrence, was appointed to prepare a design. Either from indecision, or that procrastination for which the late president of the Royal Academy was characterised, the design was never furnished, although it was a frequent and favourite theme of conversation. After an inquiry, steps were taken, however, to redeem all the pledges made by George IV to the Royal Society. The *Gentleman's Magazine* records the awards of ten medals to the following, and the reasons: Dr. Dalton, to whom was owing the development of the atomic theory, although at the eleventh hour, it was gratifying to know that he was acknowledged as its author both at home and abroad; to Mr. Ivory, the first English philosopher who introduced to Great Britain the beautiful and refined discoveries of Laplace, Lagrange and other foreign astronomers; to Sir Humphry Davy and Dr. Wollaston in testimony of services in science; to Prof. Struve, for researches respecting double stars; and to Prof. Encke, the greatest, perhaps, of modern astronomical calculators, and the discoverer of the comet which bears his name. The Duke of Sussex alluded to Sir John Herschel as one who had terminated his European labours, and a rich harvest was to be expected as the result of his labours in the ample field of a new and unexplored heaven.

The *Mechanics' Magazine*

The issue of the *Mechanics' Magazine* for January 4, 1834 opens with a reprint of a paper by Dr. Robert Hare, then professor of chemistry in the University of Philadelphia, on a galvanic rock-blasting apparatus, in which the use of electricity is advocated for mining. This is followed by a reprint of a paper by Mr. Sang, of Edinburgh, on the relation of a machine to its model. Next there is correspondence on canal improvements, and on the performances of the steam carriages of Hancock and Maceroni, followed by a note on isometric projection and a letter from John Ericsson on his caloric engine. Of considerable interest are the notices of the activities of two societies. The Marylebone Literary and Philosophical Society, it was stated, was in a very flourishing condition and had bought 17 Edwards Street, Portman Square, where it was proposed to erect a lecture room to hold six hundred persons. Sir Anthony Carlisle, Dr. Lardner and John Phillips, the geologist, were all vice-presidents of the Society, before which many eminent men lectured. Another society flourishing then was the Brighton Literary and Scientific Society, the president of which was Mr. Ricardo. The president, so the *Mechanics' Magazine* states, had just concluded a series of lectures on railways. In the course of these lectures he had read a communication from George Stephenson in which it was said that a speed of forty miles per hour had been attained on the Liverpool and Manchester Railway and that "an engine might be constructed to run 100 miles within the hour although at that rapidity of motion the resistance of the atmosphere would be very considerable indeed".

Literary and Scientific Institutions

A correspondent contributes the following statement to the *Gentleman's Magazine* of January 1834: — The number of Literary and Scientific Societies has been greatly on the increase. The Royal Society numbers 750 members, the Antiquarian, 300, Royal Society of Literature, 271, Zoological, 2,446, Horticultural, 1,875, Royal Society of Arts, 1,000; Royal Institution, 758; Geological, 700, Linnæan, 600, Asiatic, 560, Geographical, 520, Astronomical, 320. The members constituting the London Medical, Westminster Medical, Medico-Chirurgical, Medico-Botanical, Phrenological and Entomological Societies, the College of Physicians and Surgeons, and Institution of Civil Engineers, cannot be short of 1,700 persons. Next follow the London, Russel, Western and Marylebone Institutions, whose proprietary and yearly subscribers may be estimated at 1,500. Here are in the whole 13,000 names (some it is true frequently repeated) supporting 26 Associations in London, founded for the sole purpose of promoting the interests of learning and science and diffusing useful knowledge. And, for the immediate benefit of the operative class, the Metropolis possesses a Mechanics' Institute which is said to have 1,000 members.

Investigations of Terrestrial Magnetism

About 1834 great activity prevailed in the investigation of the earth's magnetism, and magnetic observations were being made not only on land but also on exploring ships. On December 19, 1833, Commander J. C. Ross described before the Royal Society his expedition to the north magnetic pole, which he reached on June 1, 1831, and his measurement of the dip as 89° 59′. This determination was made with great care, and was as accurate as was then possible. Improvements of the magnetic instruments and the elimination of errors were being actively sought. On January 6, 1834, Mr. W. Snow Harris read before the Royal Society of Edinburgh a paper "On the Investigation of Magnetic Intensity by the Oscillations of the Horizontal Needle", in which he closely examined many real and supposed disturbing factors. He showed that light had no effect on the oscillations, but that they were susceptible to disturbance by slight air currents, and the instruments must therefore be enclosed, preferably in a vacuum. He also investigated methods of suspending magnets, the effects of changes of temperature and the determination of changes in the constants of magnets.

Darwin in Patagonia

For the greater part of 1832 and 1833, H.M.S. *Beagle*, under Capt. FitzRoy, had been on the east coast of South America, and Darwin had been able to make several expeditions inland from ports such as Buenos Aires and Monte Video. Leaving the Rio de la Plata on December 6, 1833, the vessel visited Port Desire on December 23 and then sailed for Port St. Julian farther south.

Here, on January 9, 1834, Darwin records: "Before it was dark the *Beagle* anchored in the fine spacious harbour of Port St. Julian, situated about one hundred and ten miles to the south of Port Desire. We remained here eight days. The country is nearly similar to that of Port Desire, but perhaps rather more sterile. One day a party accompanied Captain FitzRoy on a long walk round the head of the harbour. We were eleven hours without tasting any water and some of the party were quite exhausted. From the summit of a hill (since well named Thirsty Hill) a fine lake was spied, and two of the party proceeded with concerted signals to show whether it was fresh water. What was our disappointment to find a snow-white expanse of salt, crystallised in great cubes! . Although we could nowhere find, during our whole visit, a single drop of fresh water, yet some must exist; for by an odd chance I found on the surface of the salt water, near the head of the bay, a Colymbetes not quite dead, which must have lived in some not far distant pool . A good sized fly (*Tabanus*) was extremely numerous, and tormented us with its painful bite. The common horsefly, which is so troublesome in the shady lanes of England, belongs to this same genus. We here have the puzzle that so frequently occurs in the case of mosquitoes—on the blood of what animals do these insects commonly feed? The guanaco is nearly the only warm blooded quadruped, and it is found in quite inconsiderable numbers compared with the multitude of flies." ("Journal of Researches".)

Societies and Academies

LONDON

Physical Society, October 20. A. F. DUFTON: Graphic statistics. The plotting of frequency-distributions is discussed. In comparing for different populations the frequency-distributions of a particular variate, it is sometimes convenient to take one population as standard and to represent its distribution by a straight line. The method of plotting individual points described by Hazen is incorrect.

December 1. H. DENNIS TAYLOR: The image-distortion and other effects due to the glass-thickness in lens systems. The optical influence upon distortion of image, or departures from correct pictorial representation, caused by the considerable thicknesses of glass involved in the construction of high-class photographic lenses of projectors having a large angular field of view is discussed. H. CARMICHAEL: The tilted electrometer. A detailed description is given of the construction and performance of a new evacuated critically damped quick-reading quartz-fibre electrometer. The sensitivity obtainable is limited only by the Brownian motion of the fibre. The minimum potential change that can be measured (with the usual convention that the corresponding deflection of the system be not less than four times the root of mean square of the deflections of the Brownian motion), is of the order of 0 0001 v when the period (undamped) is 5 sec and 0 0005 v when the period is 1 sec The range of approximately constant sensitivity is adequate for most purposes A S RAO and K R RAO Spectra of bromine v, vi and vii The vacuum spark spectra of bromine have been investigated under different degrees of excitation in the region λ 1400 to λ 400, by means of a Siegbahn spectrograph From a careful scrutiny of the plates the lines have been assigned to the different stages of ionisation of the element With the aid of these the principal members of the spectra of bromine v, vi and vii, involving the low-lying terms, have been identified. E B MOSS An automatic photoelectric photometer A precision photoelectric photometer based on principles capable of wide application and operated from A C mains is described It is a flicker instrument, but the simple shutter is on the spindle of a synchronous motor driven from the same supply as an alternating current valve bridge This is connected to an emission type photocell, and gives a directional output which automatically moves the neutral density wedge to the position of balance, which is shown by a pointer The wedge position is controlled electrically, being mounted on a galvanometer movement devoid of mechanical control G D WEST · A mechanical wave model illustrating acoustic and electrical phenomena The model consists of a series of equal masses suspended on equal lengths of straightened watch spring from a rigid bar Through holes bored in the masses, which are equally spaced, is threaded a piece of elastic One end is fixed, and the other can move with a simple harmonic motion communicated by means of a rocker arm attached to a small motor Wave transmission along the system takes place only if the frequency falls within a certain range Very high and very low frequencies are not transmitted

DUBLIN

Royal Dublin Society, November 28 J H J POOLE Some difficulties in current views on the thermal history of the earth In a discussion of various theories of earth history it is shown that, although the conditions necessary for the truth of the cooling-earth theory may now be satisfied, it is improbable that the primitive crust would have satisfied them In consequence we must conclude that partial remelting of the original crust has occurred during some stages of geological history Some points in Holmes's convection current theory of earth history are also considered, including the condition necessary for the existence of a permanent convective layer in the earth It appears that the presence of such a layer will lead to shearing stresses in the crust, owing to the greater radioactivity of the continents and the consequent distortion of the geotherms H H POOLE and W R. G ATKINS Some measurements of the brightness of various parts of the sky by means of a rectifier photoelectric cell The measurements were made in Dublin in June and July 1933 with approximately uniform skies of various degrees of clearness, the sun's altitude being 45°–60° The minimum brightness recorded was about 0 6 metre candle per square degree for a clear blue north sky altitude 45° to 60°, and the maximum 11 8 metre candles per square degree for sky covered with light cirro stratus cloud about 12° below the sun The effect of haze, and to a greater extent of light cloud, is to (*a*) increase the brightness of all parts of the sky, (*b*) cause the brightness to increase with altitude instead of decreasing, as for a clear sky, and (*c*) increase the relative importance of regions near the sun

EDINBURGH

Royal Society, December 4 J M STAGG. The British Polar Year Expedition to Fort Rae, Canada After a brief account of the activities in 1882–83 and an explanation of the ideas leading to last year's repetition, the aims of the British Party to Rae were given The methods adopted to obtain the required information in the various fields of observation were described and some indication given of the problems to the solution of which the records brought home by the Expedition will be applied

PARIS

Academy of Sciences, November 20 (*C R*, 197, 1161-1256) PAUL DELENS Isothermal congruences. S COHN-VOSSEN The total curvature of open surfaces PAUL DIENES The deformation of sub spaces in a space with general linear connexion SIXTO RIOS The singular ensemble of a class of Taylor's series which presents gaps M FEKETE and S MARSHAK Certain conditions necessary for the regularity of a function in a point of the circle of convergence RAPHAËL SALEM Fourier's series of functions of summable square ANDRE MARCHAUD Fields of semi right lines and differential equations of the first order GEORGES BOULIGAND A problem of the theory of potential JULIUS WOLFF The conjugated harmonic function of a limited harmonic function MAURICE FRÉCHET Remarks on the communications of M Minetti concerning a space composed of holomorph functions CHR FOUSIANIS A theorem of Carathéodory and Féjer W M ELSASSER The polarisation of diffused electrons ALBERT TOUSSAINT The corrections to be applied to the aerodynamical characteristics of a supporting wing under experiment in a rectangular wind tunnel, partly guided by the walls, parallel to the spread of the wing and to the velocity of the wind PIERRE DIVE Distributions of masses producing the same potential in a common interior region JEAN CHAZY The capture of comets by the solar system MLLES RENÉE CANAVAGGIA and MARIE LOUISE FRIBOURG The constants of motion of the *G*, *K* and *M* stars L. NEEL Calculation of the [magnetic] susceptibility of nickel in the neighbourhood of the Curie point ION I AGARBICEANU The absorption of iodine vapour in the presence of foreign gases Experimental study of the absorption spectrum of iodine vapour mixed with oxygen or nitrogen, under pressures varying from 1 mm to atmospheric Existing lines were enhanced, but no new ones appeared A COUDER The use of inclined lenses as a means of producing pure astigmatism in spectrographs Suggestion for eliminating more completely the effect of the grain in the photographic emulsion PIERRE BRICOUT The photometric study of the irregularities of density of photographic plates. JEAN SAIDMAN. The technique of the measurement of the thermal radiation of the skin A description of a robust form of apparatus, capable of being carried to the bedside of a patient, and of giving more accurate results than the apparatus in current use.

Some practical applications are indicated. Véron : Rectilinear wings with uniform calorific flux René Arditti · The system cadmium sulphate, sulphuric acid, water The physical properties (solubility, density, refractive index, viscosity, electrical conductivity) of this system have been studied : results are given as curves. Mlle. Sabine Filitti The oxido-reduction potential of the system hypoxanthine, uric acid Pariselle · The influence of the strength of bases on the formation of the aluminotartaric complexes Michel Magat : The energy of dissociation of water by symmetrical vibrations and the products of this dissociation Augustin Boutaric and Marius Peyraud The capillary rise of hydrosols and of solutions of colouring matters The influence of the concentration and of electrolytes Louis Médard and Mlle Thérèse Petitpas The Raman effect of solutions of ammonium nitrate in nitric acid E Burlot · The tendency to destruction of explosives by inflammation in a vacuum. A study of mercury fulminate and lead nitride (hydrazoate) It was found that there is a limiting pressure below which the destruction of the explosive is not propagated throughout the mass of the explosive In both of these detonants there is a phase of slow combustion preceding detonation This phenomenon is easy to observe with mercury fulminate ; under special conditions described it can also be seen in lead nitride. Marcu Rotbart Some arylfatty β-oxyacetals and their products of hydrolysis. Ch Courtot and T. Y. Tung · Studies in the aryl thionium series D Ivanoff and G. Pchénitchny Syntheses with amides of the type R CH = CH. CH_2CO_2H and mixed organomagnesium derivatives Alexis Chermette : New geological observations in Bas Dahomey P Lebeau · The peranthracites and the true anthracites On the basis of work described in earlier communications, the author has proposed a classification of anthracites into true anthracites and pyroanthracites, the name peranthracites now being suggested for the latter This classification is based on the volumes of gas evolved on heating to 1,000° C Further work shows other differences between the two groups : composition of the gas evolved at 1,000° C, temperatures of inflammation, decrepitation on heating, behaviour towards chemical reagents, and electrical conductivity Peranthracites are practically conductors of electricity whilst anthracites have a very high resistivity Jacques Fromaget The Trias formations of western Tonkin P. Idrac A curious phenomenon of the solfatara of Pouzzoles Jacques Bourcart An attempt at the reconstitution of the history of the fluvial network of the Haut Atlas to the east of Marrakech P. Auger and L Leprince-Ringuet Study of the variation of the cosmic radiation between the latitudes 45° N. and 38° S The action of the earth's magnetic field on the cosmic rays should serve to discriminate between the two theories of their origin, electromagnetic or corpuscular The experiments described and summarised in a graph show that the cosmic radiation is sensible to the action of the terrestrial magnetic field, at least for distances of the order of the earth's radius J Branas and J. Dulac : The mode of action of copper mixtures : the rôle of desiccation. A. Demolon and E Bastisse : The influence of the anions on the fixing and mobilisation of phosphoric acid in soils. The hydrosol of silica and humic acids play an important part in the mobilisation of the passive forms of phosphoric acid in cultivated soils. Paul Chabanaud A new type of fish of the family of Gobideæ, *Syrrhothonus Charrieri* Description of a fish caught off the coast of Tangiers by Henri Charrier R Legendre · The presence of *Anotopterus pharao* in the stomach of *germons* Polack The anomalies of colour vision The classical trichromatic theory cannot define or place the anomaly of the Rayleigh type The author's theory, which characterises chromatic vision by two factors, the position of the luminous maximum in the spectrum and the extent of the unitonal regions, gives a precise definition and forms a continuous series with normal chromatic vision and its various anomalies G Sandor, A Bonnefoi and J J Pérez · The precipitation of the proteins by neutral salts The precipitation of natural proteins by neutral salts is not due to an isoelectric precipitability The solubility passes through a maximum at the isoelectric point *p*H 6 for the globulins and is still very high at the isoelectric point *p*H 4 8 for the albumins.

Vienna

Academy of Sciences, Oct 19. Josef Lindner and Alois Torggler Convallarin. W J. Müller and W Machu Theory of passivity phenomena (23). The most important results of the earlier study of the passivity phenomena in lead are confirmed. Otto Brunner and Gertrud Wiedemann : Components of hornbeam bark The resinol found by Zellner and others in hornbeam bark has been purified and proves to be identical with the betulin of birch bark Otto Brunner and Rolf Wöhrl · *p*-Methoxy- and 3 . 4-dimethoxy-phenylurethanes. The higher aliphatic alcohols yield well-crystallising urethanes suitable for characterising these alcohols. Karl Przibram Relation between contraction and pressure for salts and metals Richard Biebl : Action of α rays on the cells of *Bryum capillare* When sufficiently intense, α-rays kill the cells of this moss, the time required being almost inversely proportional to the strength of the preparation Elisabeth Kara-Michailova . Measurement of strong polonium preparations in the large plate condenser. The advantages of this method are pointed out and curves of equal degrees of saturation for preparations of 2400-50000 electrostatic units are given Fritz Asinger · Nitration of 3 . 5-dichlorobenzaldehyde and 3 . 5-dichlorobenzoic acid At 0°, fuming nitric acid converts the aldehyde almost quantitatively into its 2-nitro derivative, and at 60°–70° the same acid nitrates 3 5-dichlorobenzoic acid to give the 2-nitro compound in about 80 per cent yield Erich Tschermak-Seysenegg . (1) Intermediate inheritance and chromosome addition with species-bastards of *Triticum villosum* (2) Size- and colour-dimorphism of the grains of wild and culture forms of rye and wheat. Karl Mayrhofer · Convergency principles with systems of ordinary differential equations. Zacharias Dische : Formation of a triosephosphoric ester from hexosephosphoric esters by hæmolysed red blood corpuscles. Franz Werner : Results of a zoological study and collecting expedition to the islands of the Ægean Sea. Descriptions of two new species, *Rhacocleis emmæ* and *Rh anatolica*, and of *Platycleis sporadarum*, Brunner v. W. Alfred Brukl and Karl Ziegler : Rhenium oxybromides. The properties of the trioxybromide and the dioxybromide —the only known oxybromides of rhenium—are described. Martin Gusinde and Viktor Lebzelter : Craniometric investigations on skulls from Tierra del

Fuego. ALEXANDER ROLLETT and RUDOLF PETTER: β-Amyrin from Manila elemi resin (6). Resins and resin substances (9). ROBERT MÜLLER, H KUMPFMÜLLER, E PINTER and B v SEEBACH: Electrochemistry of non-aqueous solutions (9): Measurement of the E M F of Ag–$AgNO_3$ concentration cells in nine organic solvents and comparison with the values calculated from conductivity measurements. ELFRIEDE ALMOSLECHNER: Yeast growth substances in *Boletus edulis* and in urine. RUDOLF SIEBER: Palæobiological investigations on the fauna of the Rotelwand Riff mass in the northern Osterhorn group.

Oct 26. GUSTAV ORTNER and GEORG STETTER: Use of pure nitrogen for ionisation chambers. The use of nitrogen offers advantages over that of hydrogen or of the rare gases. GEORG KOLLER and KARL POPL: Capraric acid. The compound $C_{20}H_{18}O_9$, obtained by the alcoholysis of capraric acid is found to be identical with cetraric acid. KASIMIR GRAFF: Colorimetric review of the stars up to magnitude 5 between the north pole and 40° south declination. ANTON E MAYER: Construction of the seven neighbour-regions (*Nachbargebiete*) on the torus. OTHENIO ABEL: Further contributions to the explanation of the creep-traces in the Greifenstein sandstone of the Wienerwald.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, January 8

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Capt Guy Dollman: "African Antelopes".*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—J T Sanderson: "An Expedition in British Cameroons".

Tuesday, January 9

PHARMACEUTICAL SOCIETY, at 8.30—(at 17, Bloomsbury Square, London, W C 1). Prof I M Heilbron: "Isoprene as a Fundamental Unit in the Synthesis of Plant Products".*

Thursday, January 11

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof C H Best: "The Rôle of the Liver in the Metabolism of Carbohydrates and Fat" (succeeding lectures on January 15 and 18).*

Official Publications Received

GREAT BRITAIN AND IRELAND

Proceedings of the Royal Irish Academy. Vol 41, Section B, No 16: The Geology of North Eastern Tyrone and the adjacent Portions of County Londonderry. By J J Hartley. Pp 217–285+plates 13–18. (Dublin: Hodges, Figgis and Co; London: Williams and Norgate, Ltd.) 2s 6d.

Royal Society of Arts. Report on the Competition of Industrial Designs. Pp 40. (London: Royal Society of Arts.)

Proceedings of the Royal Society of Edinburgh, Session 1933–1934. Vol 54, Part 1, Nos 1, 2: 1. On Fitting Polynomials to Weighted Data by Least Squares; 2. On Fitting Polynomials to Data with Weighted and Correlated Errors. By Dr A C Aitken. Pp 16. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1s 6d.

Economic Advisory Council: Committee on Locust Control. The Locust Outbreak in Africa and Western Asia in 1932. Survey prepared by B P Uvarov. Pp 74+11 maps. (London: H M Stationery Office.) 2s net.

Transactions of the Royal Society of Edinburgh. Vol 57, Part 3, No 31: Studies on the Reproductive System in the Guinea-Pig: Post-Partum Repair of the Uterus, and the Associated Appearances in the Ovaries. By Thomas Nicol. Pp 765–775+2 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 2s 3d.

University of Bristol. Annual Report of Council to Court, 1932–33. Pp 47. (Bristol.)

OTHER COUNTRIES

Bernice P Bishop Museum. Occasional Papers. Vol 10, No 2: The Lizards of the Marquesas Islands. By Karl P Schmidt and Walter L Necker. (Pacific Entomological Survey Publication 5.) Pp 11. Vol 10, No 3: Cypraeacea from Hawaii. By F A Schilder. Pp 22. Vol 10, No 4: Lysimachia, Labordia, Scaevola and Pittosporum; Hawaiian Plant Studies, 1. By Harold St John. Pp 10. Vol 10, No 5: Cryptochirus of the Central Pacific. By Charles Howard Edmondson. Pp 23. Vol 10, No 6: New Species of Amastridæ. By C Montagu Cooke, Jr. Pp 27+2 plates. Vol 10, No 7: Some Alii of the Migratory Period. By Bruce Cartwright. Pp 11. Vol 10, No 8: Notes on Pteralyxia. By Edward L Caum. Pp 24. Vol 10, No 9: The Exotic Birds of Hawaii. By Edward L Caum. Pp 55. (Honolulu.)

Obras Completas y Correspondencia Cientifica de Florentino Ameghino. Vol 10: Mamiferos Fósiles de Patagonia y otras Cuestiones. Dirigida por Alfredó J Torcelli. Pp 870. (La Plata.)

Memoirs of the Geological Survey of India. Vol 55, Part 2: The Geology of the part of the Attock District West of Longitude 72°45′ E. By Dr G de P Cotter. Pp viii+63–161+xvi+plates 11–19. 5.4 rupees; 8s 6d. Vol 64, Part 1: Barytes in the Ceded Districts of the Madras Presidency, with Notes on its Occurrence in other Parts of India. By A L Coulson. Pp viii+142+xii+5 plates. 3.14 rupees; 5s 6d. (Calcutta: Central Book Depot; Delhi: Manager of Publications.)

Whangpoo Conservancy Board. General Series, Report No 10: The Hydrography of the Whangpoo. Fourth edition. Pp v+80. (Shanghai.) 3 dollars.

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol 2, Part 9: Sur la théorie du corps de classes dans les corps finis et les corps locaux. Par Claude Chevalley. Pp 365–476. 1.40 yen. Section 3: Botany. Vol 4, Part 2: Systematic and Anatomical Studies on some Japanese Plants, 2 (Juncaceæ). By Yosisuke Satake. Pp 131–223+4 plates. 1.80 yen. (Tokyo: Maruzen Co, Ltd.)

The British South Africa Co. Publication No 2: Mazoe Citrus Experimental Station Report for Period ending 31 December 1932. Pp xx+192. (Mazoe: Citrus Experimental Station; London: British South Africa Co.)

The Bashford Dean Memorial Volume: Archaic Fishes. Edited by Eugene Willis Gudger. Article 5: The Natural History of the Frilled Shark *Chlamydoselachus anguineus*. By Eugene W Gudger and Prof. Bertram G Smith. Pp 243–319+5 plates. (New York City: American Museum of Natural History.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No 24: Regenval in Nederlandsch-Indie (Rainfall in the Netherlands Indies). Door (by) Prof Dr J Boerema. Deel (Vol) 4: Kaarten van den gemiddelden jaarlijkschen en maandelijkschen regenval op Celebes (Maps of the Mean Annual and Monthly Rainfall in Celebes). 13 maps. (Batavia.)

Ministry of Finance, Egypt: Coastguards and Fisheries Service. Fisheries Research Directorate. Notes and Memoirs, No 1: Mémoire sur l'organisation des recherches des pêcheries. Par Dr Hussein Faouzi. Pp iii+16. Notes and Memoirs, No 3: An Examination of Plankton Hauls made in the Suez Canal during the year 1928. By Dr R Macdonald. Pp 11+1 plate. Notes and Memoirs, No 4: Report on Fish Eggs and Larvæ taken during 1931. By Dr R H Whitehouse. Pp 22. Notes and Memoirs, No 5: The Pharynx and Intestinal Tract of the Egyptian Mullets—*Mugil cephalus* and *Mugil capito*. Part 1: On the Food of Mullet from Egyptian Waters. By F M Ghazzawi. Pp ii+18. Rapport sur les pêcheries d'Egypt en 1931. Par Dr Hussein Faouzi. Pp vii+119. (Cairo: Government Press.)

Japanese Journal of Astronomy and Geophysics: Transactions and Abstracts. Vol 11, No 1. Pp ii+66+20. (Tokyo: National Research Council of Japan.)

Proceedings of the Imperial Academy. Vol 9, No 8, October. Pp xxi–xxiii+347–460. (Tokyo.)

Conseil Permanent International pour l'Exploration de la Mer. Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l'Europe. Rédigé par D'Arcy Wentworth Thompson. Vol 21: Pour l'année 1931. Pp 79. (Copenhague: Andr Fred Høst et fils.) 3.00 kr.

The Imperial Council of Agricultural Research. Scientific Monograph No 7: Influence of Manures on the Wilt Disease of *Cajanus indicus* Spreng, and the Isolation of Types resistant to the Disease. By Dr W McRae and Dr F J F Shaw. Pp iii+68+16 plates. (Delhi: Manager of Publications.) 2.4 rupees; 4s 3d.

New Zealand: State Forest Service. Annual Report of the Director of Forestry for the Year ended 31st March 1933. Pp 15. (Wellington: Government Printer.)

U S Department of Agriculture. Technical Bulletin No 366: Further Investigations of the Parasites of *Popillia japonica* in the Far East. By C P Clausen, H A Jaynes and T R Gardner. Pp 59. (Washington, D C: Government Printing Office.) 5 cents.

CATALOGUES, ETC

Calendar for 1934. (Newcastle-on-Tyne: C A Parsons and Co, Ltd.)

Glycine B D H (Aminoacetic Acid). Pp 4. (London: The British Drug Houses, Ltd.)

A Catalogue of Everything X-Ray. Pp 68. (London: Cuthbert Andrews.)

Calendar for 1934. (London: British Museum (Natural History).)

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Industrial Recruitment and Educational Policy

THE valuable section in the final report of the Balfour Committee on Industry and Trade, which considered education as a factor in industrial and commercial efficiency, emphasised the urgent need for each great industry to make its own educational needs the subject of thorough and systematic examination, "particularly because the changing forms of organisation and mechanical equipment and the subdivision of occupations which characterise some of the more important industries are continually modifying the nature and extent of their educational needs, and these changed needs can only be fully known to those actually engaged in industry"

The five years which have elapsed since this report was presented in March 1929 have subtracted nothing from the cogency of its argument On the contrary, the growing intensity of international competition supplies a strong insistent force, which was previously lacking, impelling those engaged in industry and commerce to consider how they should improve the efficiency of their personnel as well as of themselves It has become clear, too, that those personal qualities, on which we have relied in the past far more than on specialised knowledge, are by themselves inadequate to meet modern demands for leadership and must be supplemented by greater knowledge and a wider outlook Finally, the chaotic conditions to which the economy drive of the last two years have reduced education in Great Britain are causing misgivings in the minds of the most stubborn regarding the capacity of the next generation—whether in rank and file or in leadership—to maintain our higher standard of living in the face of modern competition

Suggestions for co-operation between industry and educational authorities have frequently been put forward, and were indeed worked out in detail in the report of the Malcolm Committee, which recommended that the Board of Education should establish a small special body representative of the views of employers, workers, local education authorities and teachers to undertake national negotiations In the report on Trade Schools on the Continent, which was issued in 1932, two inspectors of the Board of Education directed attention to the danger to our industrial efficiency which is presented by the growing vertical immobility of labour, as well as to the necessity of organising our institutions for technical education less in response to a demand from below and more in response to the actual requirements of industry as seen by its leaders In his recent book on "Education for Industry and Commerce in England", Mr. A Abbott makes an even more emphatic plea for a complete review of our methods of industrial recruitment, training and promotion He urges that each industrial organisation should consider carefully first what types and grades of workers it needs and in what numbers and secondly, from what types and grades of schools these should be drawn

The relation between industrial recruitment and educational policy and development has been overshadowed by the unemployment question, but the growing extent of juvenile unemployment is once again focusing attention on this problem If only as a means of checking continuous recruitment into occupations where juvenile employment is already disastrously high, steps must be taken to afford the youth of the country suitable training for those industries which can offer them a reasonable prospect of employment and advancement in their chosen work, they must not be left to enter those which are merely exploiting wholesale their defenceless situation

As a first step to this end, it is obvious that each industry must be able to formulate its own requirements and to do so continuously, so that with the selection of recruits there is associated a definite plan of training and promotion In spite of the discussions which have centred round training for management, and the care which is now taken in some industries in the training of recruits, whether drawn from the universities, from technical schools or from secondary and elementary schools, the bearing of the developments in post-primary education recommended under the Hadow scheme on industrial recruitment and promotion is as yet scarcely realised by industry The net result of educational selection at the age of eleven years for post-primary or other schools with a leaving age above fourteen, will be that the members of the selected group will greatly outstrip those of the unselected group in competition for the more responsible and attractive posts of industry Its responsible officers will to an increasing extent come from a group of individuals picked out at an early age for prolonged education, and its rank and file will come from the larger group of individuals not so selected

It is accordingly desirable not merely that industry shall formulate its requirements as to the training to be given before and after recruitment, the standard and type of education desirable in its recruits, whether for the rank and file or for the more responsible positions It is equally important that the whole methods of recruitment should be reviewed and modified or replaced by better methods desirable Recruiting policy must take account of the changed conditions of education and not be content to follow blindly the methods of generations ago, regardless of their suitability or unsuitability

There is little doubt that a re-examination of recruitment policy would speedily result in enlisting a considerably higher proportion of students who had received a good previous education in part-time classes of the technical schools, and thus tend to raise the general standard of the rank and file of industry The quantitative aspect of recruitment is, however, equally important Each industry should be able to give a reasonably accurate estimate of the number of recruits it expects to require during a period of years from each class of school—those with students at a leaving age of fourteen years. the post-primary schools and the technical schools giving a full-time education up to eighteen and those coming from the universities or technical colleges of university rank

Industrial planning on this scale is long overdue The mischief which has been done by extravagant statements regarding the demand for chemists or other classes of scientific workers, for example, causing an influx of students to such courses in numbers far exceeding the capacity of the industry to absorb them, is difficult to assess but has been widespread in the last decade Similar or even more vicious conditions are to be found among every category of student from the elementary school upwards Even at the present time such industrial planning cannot be dismissed as impracticable or visionary Such books as Prof G C Allen's "Industrial Organisation in Great Britain" have demonstrated the imperative need for industry to face the facts, if any, if our lost prosperity is to be recovered or indeed our standard of life maintained

One incidental result of such an estimate would be to bring out into clear relief those industries which are making little use of men with a wide and thorough scientific training, or relying entirely on relatively untrained sources for the recruitment of their rank and file Lack of efficiency, because those responsible for the direction of an industry did not possess sufficient knowledge and training to make use of the facts now available for them, would be speedily correlated with its true cause, and the community would be in a strong position to refuse to allow palliatives in place of remedial measures.

On this ground alone some opposition may be expected to any proposals for the planning of a policy of technical education and industrial recruitment. The advantages which such a policy offers, however, are too solid to be thwarted by mere reactionary or prejudiced views There is first the imperative necessity of securing for the service of industry competent workmen and skilled foremen, who possess the ability to meet the demands of this age for a new kind of skill based on considerable intelligence, a sound general education, a willingness to develop fresh interests and a capacity for adaptation to fresh tasks Secondly, there is the advantage of securing the staffing of industry generally with university graduates, or men with wide scientific knowledge and training, not merely for the purpose of research but also for securing that full advantage is taken, in every sphere, of the new tools which science is constantly forging, whether for new production, increased efficiency, or the safeguarding of life and health

We here touch on perhaps the most fundamental need of all It is probably true to-day that most, though not all, industries have a research organisation in one form or another which is adequate to their present needs, and there are indeed a number of industries in which new knowledge is being gained more rapidly than it is utilised There are, moreover, many branches of industry in which there is no real hope of applying the new knowledge gained by the various research organisations until the qualifications of the men at the top have been improved

This is largely a matter of training for management, of seeing that those recruits for industry who are destined ultimately for its management or administrative staff should have had a broad general education on which they have built a first-rate scientific education Apart from the absolute necessity of adequate scientific knowledge for sound and prompt decisions as to whether and how a new piece of knowledge can be utilised, whether its utilisation is likely to be permanently profitable, its reaction on other production and development, whether a difficulty encountered in works practice should be solved on the spot or more wisely referred to a research organisation or department, the significant check to the vertical mobility of labour makes the old haphazard habit of recruitment for management inadequate We can no longer expect that recruits of the requisite calibre will continue to work their way up from the bottom, or that those who do raise themselves to some extent will possess the wide knowledge and breadth of vision required of those in administrative or managerial posts.

Technical knowledge is, of course, only one of the factors required in the higher management of industry It is equally important that a policy of industrial recruitment should take full account of the various institutions, such as the Department of Business Administration at the London School of Economics, of Industrial Administration at the University of Manchester, or the Institute of Industrial Administration, which are specifically directed towards training for management The training given in those courses must be regarded rather as fitting the students to take fuller advantage of their industrial experience, and to qualify themselves ultimately for the more efficient discharge of administrative duties The courses are not a substitute for wide technical and scientific training They are rather complementary, and require planning in close relation to industrial requirements and opportunities, if mobility of staff on the technical side is not also to be discouraged

The demand which a policy of industrial recruitment makes for co-operation between industry and educational authorities is obvious It is less apparent, however, that its achievement demands a widespread interest in the community, and particularly a general conviction that technical education is a most powerful instrument for maintaining and increasing technical efficiency Unless public opinion regards technical education not as an attempt to train well-disposed and ambitious individuals for higher posts but as a definite effort to train an industrial army, officers and rank and file alike, which by its *moral* and technique will safeguard and strengthen the economic life of the State, there is unlikely to be forthcoming the support which will undoubtedly be necessary if the opposition of such backward industries as the cotton industry to a planned policy is to be overcome.

There are at any rate signs that a considered policy is within the bounds of possibility. The alarming position of juvenile unemployment in Lancashire has already focused attention on the exploitation of juvenile labour in the cotton trade in the absence of a recruiting policy, and has led the Lancashire authorities to initiate their own plan for raising the school age and working the Hadow scheme A definite policy with regard to the recruitment of laboratory assistants for scientific laboratories, who in the past have provided an unhappy example of a blind alley education, has already been adopted by some industrial firms and promises to mitigate or avoid this difficulty. In addition, there is a growing tendency for professional organisations of scientific workers, such as the Institute of Chemistry, to interest themselves in technical education, whether in post-graduate classes, or in the training for higher positions in evening or part-time classes of those already engaged in industry

The association of scientific workers is an essential element in the elaboration of an adequate policy The task of educating public opinion as to the bearing of technical education on industrial efficiency, whether among the leaders or the rank and file, must fall largely on them On their researches and investigations the continuous development of technical education depends In their personal capacities, whether in industrial or educational posts, they must make important contributions to the detailed elaboration of policy There are few fields in which larger demands for public service are made on the profession of science than in just this field of technical education, upon which the industrial future of Great Britain now so closely depends

The solution of our problems of education for industry and commerce, and the elaboration of adequate and harmonious relations in regard to recruitment between industry and education, depend largely upon the capacity of the organised scientific industrial and commercial professions to exert deliberately and continuously the same liberalising influence on standards of education as the so-called liberal professions have exerted less consciously and actively in past centuries Technical education from one point of view is the training of industrial personnel, and this is an essential factor in the permanent recovery of industrial prosperity From another point of view it is the use of applied science as a means of higher education , and to demonstrate our ability to use applied science as an agent of education as previous generations used the classics may well prove to be one of our greatest achievements in this century.

African Folk-Lore

Myths and Legends of the Bantu. By Dr. Alice Werner. Pp. 335+31 plates (London, Bombay and Sydney . George G. Harrap and Co , Ltd., 1933.) 15*s*. net

DR. WERNER is best known in the field of African philology, for her knowledge of Bantu tongues is probably unique, and beyond doubt these acquirements have greatly facilitated her researches into the mythology of the people dealt with in this work. Such a patient and discerning investigation must therefore command great respect

Folk tales have, through the ages and all over the world, always had an attraction for mankind, otherwise they could not have survived, but it is only during the last fifty years or so that they have received attention from analytical minds. Thanks to the researches of E B Tylor, Sir James Frazer and others, the study of the legendary lore of primitive folk has been accorded a definite place in anthropological science, and its importance is now fully recognised As the author remarks in her preface, it now seems incredible that Moffat in 1842 could state that a description of the manners and customs of the Bechuana would be "neither very instructive or edifying", and another distinguished missionary referred to the "absurd and ridiculous fictions" of the tribe. This attitude persisted in East Africa to much more recent times, but information dealing with beliefs, customs and arts has of late years poured in from all quarters

We have in the work before us a *corpus* of mythological material the wealth of which is staggering, and it is only owing to its painstaking division into classes by the author, that the student can obtain a grip of the essentials.

As will be well known to most, the term Bantu has little racial significance, for it refers solely to a language group of people. That is to say, over a vast extent of Africa we find masses of people, often of diverse physical characteristics, all speaking languages referable to the same original tongue. The persistent uniformity of structure in the various branches of Bantu speech over such a vast area is a remarkable phenomenon, when we consider that it was adopted by many racial groups which must have had languages of their own, and of which there is now but little trace.

Besides the language relationship, there is another remarkable fact, namely, that those to whom a Bantu language has become the mother tongue have, generally speaking, the same religious beliefs. All are monotheists, although the idea of a high god is often not clearly distinguished from the sun, the sky and even the first ancestor of the tribe The basic fact in their religion is, however, the belief in the power and influence of the dead, whence it follows that they believe in survival after death, for they are convinced of the intervention of the spirits of the departed in the affairs of the living. This fact is relevant to the origin and survival of their mythology, for if this belief had not existed, much of it could never have been born. The folk tales give an invaluable insight into the workings of this belief, for it would appear that although they rarely see the dead in the flesh, the spirits reappear in the guise of birds, sometimes as snakes and even as children The spirits of the dead sometimes exercise a moral influence and there are several cases where a murderer is detected by the intervention of a spirit personified in the shape of a bird They may inflict punishment, too, if neglected, or as a judgment on some undiscovered lapse in tribal law.

The unfettered power of metemphycosis which is believed to be possessed by the spirits of the dead has played a great part in the development of the folk-lore of Africa, and for that reason the connexion between the religion of these people and their mythology should not be lost sight of, even if it does not explain all.

The belief in heroes and demi-gods flourishes among the Bantu-speaking peoples, quite in accordance with the legendary myths of the classics and of the Norse lands The lives of the famous Ryang'-ombe, Liongo and others may be quoted. The birth of the hero often occurs in unusual circumstances and he skips adolescence, acquiring mature strength with miraculous rapidity, his precocity is such that any attempt to kill him is at once detected. Around some of these figures quite a *saga* of legends has accreted, and although many of the happenings are impossible, there may be a basis of historical fact. Belief in these characters persists among the people of Africa even to-day.

Next comes the folk-lore, in which animals play a great part. Included in this group of legends are the stories in which the special feature is a swallowing monster, which is eventually killed by a hero and then all is well, for its victims emerge unharmed We have here reminiscences of the 'Giant Killer' and Jonah of whale fame so familiar to all of us.

In the animal group we have, too, a multitude of stories which fall into what may be called the "Brer rabbit" class, made famous throughout the civilised world by "Uncle Remus" Needless to say, in Africa the rabbit is really the hare, for there are no rabbits. The general motif of the stories is that a small beast, physically weak but blessed with cunning, defeats slower witted but stronger beasts such as the lion, elephant, etc. According to local taste or for some recondite reason, the place of the hare is sometimes assumed by the chameleon—which, by the way, is blamed for the introduction of death—the jackal, and as for the tortoise, he comes into a group of stories of his own It is the "old man Tarrypin" of the Uncle Remus collection

The occurrence of the triumph of small defenceless creatures which is such a feature of these stories, excites curiosity The author considers that it is stressed owing to a natural sympathy for the 'under dog', others are inclined to emphasise the African tendency to exalt low cunning Both reasons may have an influence

The detection of similarities in mythical stories from parts of the world remote from each other has for long given rise to astonishment and has often led to controversy Diffusion throughout the Bantu-speaking language group has obviously occurred, but so far as can be ascertained, the myths do not appear to afford much argument for their dispersion from that much-favoured centre—Egypt It is true that, in her final chapter, the author identifies a limited number of legendary stories as being, for example, similar to such well-known folk-tales as Cinderella, to stories from Assam, the Buddhist Jatakas, even the medieval "Gesta Romanorum", and so on. Truly folk tales may be said to have travelled even more extensively than ancient beads.

It is, of course, impossible here to do more than refer to a few of the most striking examples of legendary lore which are set forth in this volume While expressing appreciation of this work, may one say that it is impossible to avoid a regret that the learned writer did not give us her views regarding the genesis of the mythical material, and also discuss the mental processes which have produced such an amazing mass of legendary matter. The work is well produced and is illustrated by a series of excellent photographs of an apposite character. C. W. H.

Science and Railways

A British Railway behind the Scenes: a Study in the Science of Industry By J. W Williamson. Pp. x+213+25 plates (London. Ernest Benn, Ltd, 1933) 5s net

THIS book is a study in the application of science to industry, as exemplified in the organisation, operation and development of the London Midland and Scottish Railway. The author discusses the design, building and repair of locomotives and rolling stock, the construction and maintenance of the permanent way, signalling, operation and control of traffic, 'rationalisation' and costing, and scientific research There is also a brief chapter on the many interests of the undertaking which are ancillary to its main business of transport

The London Midland and Scottish Railway was incorporated ten years ago, under the Railways Act of 1921, through the merging of eight constituent and twenty-seven subsidiary companies with an aggregate authorised capital of approximately £424,000,000. Interesting details are given which indicate the remarkable range and diversity of this gigantic corporation's activities For example, we are told that in 1932, transport facilities were provided for 407½ million passengers, and 117 million tons of freight As an employer, the undertaking rivals the Post Office, with a staff of approximately 225,000 persons In addition to rail transport, it controls and operates docks, steamships, canals, motor and horse-drawn vehicles It also incorporates the largest hotel business in Europe, whilst staff duties range from engineering to weed-killing, and from scientific research to the provision of dance bands

Few industrial trends are so full of promise as the adoption of scientific research and the scientific method by modern business corporations In 1930 the L M S Railway, inspired and encouraged by Sir Josiah Stamp, appointed a research committee with Sir Harold Hartley as director of research The activities of the committee are closely linked to the company's costing system, which discloses the desirability of making investigations. Research is thereupon initiated, the primary object of which is to effect economies in working, whilst also aiming at greater efficiency and safety throughout the system. Sir Harold Hartley is quoted as saying that "the outlay has already been repaid by results achieved, and we look forward with confidence to the cumulative effect of continuous scientific study and research". There is no central research laboratory, since it is considered better policy to take full advantage of facilities provided by the research organisations of the Department of Scientific and Industrial Research, the universities and industrial research associations The undertaking has chemical laboratories of its own at Derby, Crewe, Horwich and St Rollox, and specialised laboratories dealing with paint, textiles, metallurgy and the mechanical testing of materials

It would manifestly be impossible to give more than a bare outline of the company's far-reaching activities within the limits of this book The outline provided, however, is one that conveys to the reader a satisfactory impression of the undertaking as a whole and as a going concern Considerable difficulty must have been experienced by the author in selecting his material, and he is to be congratulated upon the successful manner in which he has accomplished this task The book is agreeably written, it is competently planned and the balance of the chapters is well maintained

Although ostensibly limited to an exposition of how this great railway functions, the book may also be regarded as a contribution to the study of industrial administration It is not that there is anything strikingly novel about the administrative methods discussed. There is already an extensive literature on railways in general, and a literature at least equally voluminous dealing with subjects such as simplification, standardisation, processing, planning and costing In particular a vast amount of theory, hypothesis and (may we whisper it?) 'hot air' has been evolved in recent years to which the name 'rationalisation' has been applied

It is well for the student of industry, who is increasingly compelled to follow scientific method in his studies, to leave this somewhat rarified atmosphere from time to time and turn to the contemplation of theory in process of successful application to practical business affairs "The great benefit which a scientific education bestows," said T. H Huxley, "is dependent upon the extent to which the mind of the student is brought into immediate contact with facts." Immediate contact may be supplemented to advantage—at least where industrial processes are concerned—with the indirect contact afforded by books such as that under review. Therein lies their chief value to all students of industrial organisation and management

Oil and its Uses

Earth Oil By Dr Gustav Egloff (A Century of Progress Series) Pp xi+158 (Baltimore, Md · The Williams and Wilkins Co., London. Baillière, Tindall and Cox, 1933) *5s 6d*

THE word oil is a household one to-day, since the ingenuity of man has found a myriad uses for it As 'petrol' in England, 'gasoline' in America, 'essence' in France, it serves as the source of power to propel cars for work and for play, while as a social influence it may be claimed to have altered the habits of nations It behoves us, therefore, to know something of oil, perhaps of its history and the methods of locating it, but certainly about the methods of mining or drilling for it, its storage, transportation and refining, including those modern developments of the oil technologist and oil chemist such as cracking and hydrogenation Even the subject of oil resources has its interest, whilst it is of great economic and strategic importance It is to fulfil such requests that this little book has been written The author, Dr Gustav Egloff, who is a deservedly popular leader among petroleum technologists, is able with his pen, aided by numerous illustrations, to portray for us almost in moving picture form the oil story, and well he does it

It is certain that the uses for oil will increase and that it is almost an ideal material for the internal combustion engine It is a strange reflection on international economics that those countries which lack oil are seeking to replace it by substitutes and protect these by taxation The world's use of oil to-day is far below the producing capacity of the actual wells, of which 330,000 are producing in the United States alone at an average rate of seven barrels per well per day Vast reserves both known and undiscovered are left underground, further, the newer methods of production and refining all give far higher yields of product from a ton of crude oil There is thus no fear of an oil shortage, but every encouragement to go on to make more use of it

The past summer has seen the holding of the first International Conference of Petroleum Technologists at South Kensington, at which all matters pertaining to oil were discussed among experts Its outstanding success indicates the certainty of further progress in every direction

One aspect still baffles us, namely, the origin of oil It is a subject for the geologist to tackle in addition to his task of locating oil—this last a subject in which enormous strides have been taken as a result of the co-operation of the physicist Crude oil sometimes has much, at others little, sulphur and the same applies to nitrogen Different crudes vary in almost every respect—some are nearly all gasoline, as in California, some are practically solids No one theory of petroleum production is in any way satisfactory The earth is generous to mankind perhaps oil is one of her greatest gifts and those lands which have it are specially favoured

The book is issued in connexion with the Chicago Century of Progress Exhibition. few would dispute the claim of the oil industry to be in the forefront of such progress E F A.

Short Reviews

Lehrbuch der okologischen Pflanzengeographie Von Prof Dr Eug Warming und Prof. Dr P Graebner Vierte Auflage Lieferung 5 (Schlusslieferung) Pp viii+961–1157 (Berlin Gebrüder Borntraeger, 1933) 18 gold marks.

THE publication of the fifth part completes the fourth edition of Warming and Graebner's "Lehrbuch der okologischen Pflanzengeographie" The sclerophyllous vegetation of districts with winter-rain, subxerophilous grass formations, and deserts are here considered A final chapter deals with the struggle between plant communities Title-page, preface, contents and index are also included

The new edition is a most important work of reference and gives an excellent summary of world vegetation and of the causal or correlated physical and biotic factors. It is written in relatively simple language without undue stress on technical terms. Most of the illustrations are adequate and some are excellently reproduced and very instructive, but no attempt is made to illustrate the distribution of the communities or 'formations' by maps. The most unfortunate feature is the bibliography Only an appendix to the literature listed in the third edition is given, and to trace most of the papers quoted, reference to this earlier edition is necessary So many important post-War English and American books and papers have been overlooked that a false impression is given that ecological and phytogeographical studies are not being pursued with any intensity outside Central Europe

The death of Prof. Graebner, while this last part of the "Lehrbuch" was in press, is recorded with deep regret. W. B. T.

The Book of Chemical Discovery. By Leonard A. Coles. Pp. 288+31 plates. (London, Bombay and Sydney: George G Harrap and Co, Ltd., 1933) 7*s*. 6*d*. net.

EVERY book that makes the achievements of science and its problems known to a wider circle of the public is to be welcomed. Mr Coles gives a judicious blend of the past, the present and the future—wisely in our opinion, for he who would understand the future must venerate the past. The story of the dawn of chemistry, of the age of alchemy, is far more interesting than that of the lives of the contemporary kings and queens and their favourites, if only we could persuade the public to read the former instead of the latter. Even the daily Press now takes notice of atoms, molecules and electrons with the transmutation of the elements a fact, the wheel of progress has taken a full turn.

Mr Coles is happy in his treatment of the industrial section, though it might perhaps be a little more up to date, even if the latest wonders of synthetic production are a little more difficult to explain His final chapter on problems will leave his readers thoughtful, conscious of the progress which is being made and of how much remains to be done.

The book is far more accurate than many similar efforts, and as it wisely confines its ambit, it is able to cover the subject very completely · it is an ideal school prize or present. E. F. A

Handbuch der landwirtschaftlichen Bakteriologie Von Prof. Dr F. Lohnis Zweite, neu bearbeitete Auflage Band 1, Teil 1. *Futtermittelbakteriologie* Von Prof Dr F. Lohnis. Pp. 105 10 50 gold marks Band 2, Teil 1· *Dungerbakteriologie* Von Prof Dr. G Ruschmann. Pp 158 15 gold marks (Berlin Gebruder Borntraeger, 1933)

THE old "Handbuch" of the late Prof Lohnis has been enlarged, these parts being the first of the second edition to appear The price may seem high for paper covers, but the fund of information supplied is very rich, so that the work will be of great value on library shelves individual workers will appreciate the new edition, though few may be able to buy it as a whole

Without slighting the text, it may be said that the extensive running bibliography—which frequently occupies more than half of the page—will be the feature most sought after The plan of Band 1, Teil 1, includes discussions on bacteriological aspects of the preparation and self-heating of hay; silage; decomposition processes, and their control, in various types of fodder; technique of examination; and an especially interesting section on the rôle of micro-organisms in animal digestion. The plan of the larger part ("Farmyard Manure") is comparable. The work is generally up to date, though no description of the A.I.V. ensilage process is given.

The Outlook of Science: Modern Materialism. By R. L. Worrall. Pp. v+203. (London: John Bale, Sons and Danielsson, Ltd., 1933.) 8*s*. 6*d*. net.

IN this useful and provocative work, the author denounces the idealistic tendencies of modern science and pleads for a revival of philosophical materialism. It is true that the extensive mathematisation of science has carried away from reality some of our most prominent men of science. A series of well-chosen quotations from leading physicists and biologists are taken as a basis by the author for a searching criticism of their idealistic point of view. The sympathy one may feel for the author's critical endeavours, however, can scarcely be lavished on his constructive conclusions Inspired by the crude materialism of the Russian thinkers, the author gives as a keynote of his philosophy the very controversial assertion that mind is derived from matter. The elaboration of a tempered dualism would have saved him from many pitfalls T. G.

The Handbook to the Roman Wall· a Guide to Tourists traversing the Barrier of the Lower Isthmus By the late Dr. J Collingwood Bruce. Pp x+221+1 plate Ninth edition (Newcastle-on-Tyne: Andrew Reid and Co, Ltd; London: Longmans, Green and Co, Ltd, 1933) 3*s* 6*d* net

A FAMOUS handbook, written seventy years ago and now in its ninth edition, would call for little comment, if it were not that it is claimed by the editor, Mr R. G. Collingwood, than whom no one is more competent to pronounce an opinion, that it is now the most complete account of the Wall that has appeared since 1867 Much matter of antiquarian interest that would now be considered irrelevant has been excised, the information has been brought fully up to date, and a bibliography appended The utility of the handbook has been enhanced while its attractiveness as an account of the Wall is unimpaired

Earth-Lore Geology without Jargon. By Prof. S J Shand. Pp viii+134+4 plates (London. Thomas Murby and Co., 1933) 5*s* net.

IN his latest book Prof Shand outlines the major facts of geology and touches lightly on some of its unsolved problems The subjects dealt with include. earth sculpture, the sea floor, the age of the earth, the problem of the mountains, and drifting continents.

The book appears to be intended for those of the thinking public who may wish to know what geology is and what geologists are thinking about to-day. The use of 'jargon' has been very largely avoided and simple explanations have been furnished for such technical terms as are used.

"Earth Lore" should appeal not only to the wider public for which it seems to have been expressly written, but also to students of geology who require an up-to-date conspectus of their own subject.

Sheffield Steel

THE intimate association of Sheffield with the steel industry is probably even better known and appreciated than the proverbial relationship between coals and Newcastle. In the former case the industry has developed practically from its very birth within this city to its present unshakable and unique position in the industrial world, and although steel-making in England is now rather more decentralised than was formerly the case, Sheffield still holds pride of place in respect of both historical associations and present-day importance

The rise of Sheffield as a metallurgical centre may be attributed in part to certain natural advantages and to the gradually accumulated skill of generations of craftsmen of the city, but pre-eminently it must be ascribed to the important contributions made to steel metallurgy by such men as Huntsman, Bessemer and Sorby. It was here that Benjamin Huntsman, in the years between 1730 and 1740, conceived the idea of melting the carburised bars of Swedish wrought iron in crucibles, and persevered with his experiments until the practical difficulties associated with this novel procedure were surmounted. The Huntsman method of melting and casting proved a great advance on the methods then in use for the production of shear steel by hammering the bars of carburised wrought iron, and gave a much more uniform and coherent product From this time onwards to the middle of the nineteenth century, the crucible process of steel-making developed rapidly in Sheffield, and the tool steel produced acquired that reputation for quality and reliability which has characterised all Sheffield products down to the present day.

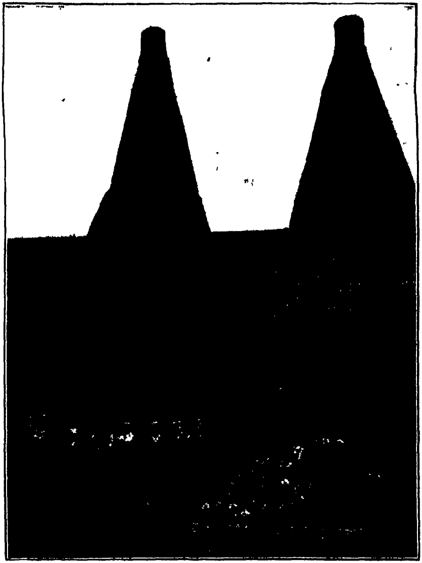

FIG. 1. Huntsman's original works and furnaces Reproduced by courtesy of Sir Robert Hadfield.

Some time after the rise of the Huntsman process, it was found possible to combine carburisation and fusion into one operation by melting together a mixture of Swedish wrought iron and charcoal, and, eventually, attempts were made to substitute English wrought iron. The latter procedure was eventually made commercially practicable by the introduction of manganese into steel-making, due to Heath, who in 1839 took out a patent covering the addition to cast steel of manganese in the form of a carbide, prepared by roasting manganese dioxide with carbonaceous matter.

Then followed the Bessemer process for the treatment of molten pig iron by blowing air through it. This process, which was put on a commercial footing in Sheffield, made it possible to produce structural steel cheaply and in reasonable quantity. Later came the development of the open-hearth regenerative furnaces by the brothers Siemens, working in conjunction with Pierre Martin The Siemens-Martin method made possible the huge outputs from individual furnaces which have characterised more recent years, and also led the way to the development of the long list of alloy steels now in use for a variety of engineering purposes

Again, it was a citizen of Sheffield, Henry Clifton Sorby, who devised the microscopic method of examining the structure of metals and laid the foundations of the science of metallography and the technique of heat treatment Sorby first described the various constituents and structures met with in steel—the pearly laminæ, surrounded either by areas of soft iron or by membranes of a much harder constituent—and thus enabled rational and coherent ideas to be substituted gradually for the atmosphere of mystery and secrecy which had surrounded the operations of steel-making.

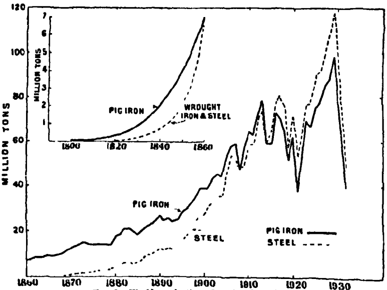

FIG 2. World production of steel and pig iron

Two books recently published* place on record much that is of absorbing interest in connexion with the development of the steel industry. Both authors are able to give personal experiences of the steel-making days of more than half a century ago, yet both are still actively interested in modern technique and production methods

Sir Robert Hadfield's address of welcome to the members of the Iron and Steel Institute who visited Sheffield for the autumn meeting of the Institute is an attractively prepared brochure containing an unique collection of nearly a hundred photographs of past and present metallurgists, and should be of considerable interest and value to those connected with the Sheffield industry or with the University of Sheffield A vivid sketch is given of the rise of metallurgical industry, with particular reference to the City of Sheffield, together with a miscellany of historical references and personal reminiscences. Throughout the book stress is laid on our great debt of gratitude to the workers of the past, both inventors and craftsmen, upon whose labours the structure of modern steel metallurgy has been erected

An interesting account is given of the details of Huntsman's method of manufacturing crucible steel, as witnessed by the French metallurgist, Gabriel Jars, and described by him in his "Voyages Metallurgiques", published in 1774 The historic photograph here reproduced (Fig 1), of Huntsman's original works and furnaces, gains in interest by reason of the fact that it was taken by the late Prof J O. Arnold, of the University of Sheffield The following section surveys the rapid expansion which occurred between 1750 and 1850, owing to the development of the Bessemer process, the Siemens-Martin process, and the basic Bessemer and open-hearth processes The rise and development of alloy steels are discussed, with particular reference to the Hadfield inventions of manganese and silicon steels Mention is also made of the newer types of heat and corrosion resisting steels, but surprisingly little is said on the subject of the high duty structural steels for automobile and aircraft purposes, which to-day constitute a considerable proportion of the total output of alloy steels An interesting diagram, here reproduced (Fig 2), shows the total world's output of steel and pig iron from 1800 down to 1932.

Succeeding chapters deal with the growth of metallography and heat treatment, the associations of Sheffield with national defence and the manufacture of armaments, and the importance of industrial research Probably the most interesting section of Sir Robert Hadfield's address is that surveying the development of metallurgical education in Sheffield, and the work of the Faculty of Metallurgy in the University under the successive professors, Greenwood, Arnold, Desch and Andrew. Reference is made to the research department for the cold working of steel, and to the recent project for the establishment of a degree course in foundry work

Some interesting details are given of the formation of the Iron and Steel Institute in 1869, and of the important part played by the Institute in encouraging research and disseminating knowledge in ferrous metallurgy, and we can heartily commend Sir Robert's advice to all interested in the iron and steel industry to become associated

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* "Address of Welcome to the Iron and Steel Institute visiting the East Hecla Works of Messrs Hadfields, Ltd , on September 14, 1933 " Pp. viii+112. (London Chapman and Hall, Ltd.) 5s

"Steel-Makers." By Harry Brearley Pp. xiii+156. (London, New York and Toronto· Longmans, Green and Co., Ltd , 1933) 5s net with this body The address closes on a note of encouragement to the younger generation of metallurgists, for whom the future holds in store a wealth of opportunity

Mr Harry Brearley's book makes exhilarating reading His main thesis concerns the value of the judgment and vision of the workman—of the art as opposed to the science of steel-making. This idea is developed with the aid of some pertinent thrusts at the too highly scientific metallographer or chemist, who is apt to use a language which only the initiated can understand and to become unintelligible to those who dutifully read his reports "There are complaints that what should be, or might be, a clearing house for difficulties is apt to degenerate into a priestcraft able to obscure a difficulty if not explain it "

Mr Brearley has some hard things to say on the subject of the teaching of metallurgy and the comparative neglect of the process side of steel metallurgy "And as what the schools call metallurgy turns out to be almost exclusively metallography, there is little wonder that the graduate student comes into the works with notions about the importance of this or that which are sadly out of balance . As a supplement metallography is excellent as a superseder of the older forms of observation and deduction it may not be so excellent—it may be misleading What a man sees through a microscope is more of less, and his vision has been known to be thereby so limited that he misses what he is looking for, which has been apparent at the first glance to the man whose eye is informed by experience " This leads to views on technical education which are definitely constructive, and a very interesting and attractive suggestion is put forward for the teaching of steel metallurgy under industrial conditions

Mr Brearley's book is in part autobiographical, dealing with the author's early days as a cellar-lad in a tool-steel furnace—an occupation he entered at the age of eleven or twelve—with the intimate details of the crucible process as practised in Sheffield in the 'eighties, and with his admiration for the skilled steel-melters with whom he came in contact "The goodness of the craftsman is in his bones and beats with his blood The same unruffled confidence, and modesty too, which unfolds itself in men like Faraday unfolds also in humbler workmen , and whilst in them uncouth expression might be mistaken and misunderstood, there are such men whose opinion, muttered in their sleep, is valuable beyond the calculated views of others Amongst even steel-melters there are 'mute, inglorious Miltons' " L B H

The Asiatic Society of Bengal

By DR L L FERMOR, O B E

AS the Asiatic Society of Bengal is arranging to celebrate on January 15 the one hundred and fiftieth anniversary of its foundation, a short account of its activities will be of interest

The founder of the Society, Sir William Jones, a Puisne Judge of the Supreme Court at Fort William in Bengal, arrived in Calcutta in 1783 Sir William Jones, who was a distinguished scholar and linguist, soon noticed the want of an organised association as a drawback to progress, and with the co-operation of his friends held a meeting on January 15, 1784, at which thirty gentlemen representing the *élite* of the European community in Calcutta were present Sir William Jones delivered a "Discourse on the Institution of a Society for enquiring into the History, civil and natural, the Antiquities, Arts, Sciences, and Literature of Asia" ; and as a result of this address it was resolved to establish a society under the name of the "Asiatick Society" The name adopted for the Society at the inaugural meeting was borne on the records until the close of the fourth decade of the nineteenth century

In 1829, soon after the foundation—by Henry Thomas Colebrook, a former president of the Asiatic Society—of the Royal Asiatic Society of Great Britain and Ireland in London, and the affiliation of the Literary Society of Bombay with that institution, a letter was received from the Royal Asiatic Society offering to the Asiatic Society in Calcutta the privilege of affiliation, and in this letter the Asiatic Society was for the first time designated as the "Asiatic Society of Bengal" The Society did not accept the affiliation or the change of title, but as the parent of all the Asiatic Societies extant it fitly retained its original name of *The* Asiatic Society In 1832, also, when Mr. James Prinsep sought the sanction of the Society to use its name for the journal he was then about to start, the resolution used the words "Asiatic Society" only , but the editor found it convenient to add a local designation and, in 1843, when the journal became the property of the Society, the new name of Asiatic Society of Bengal had already become familiar and it was formally introduced into the code of by-laws published in 1851 This title has been used continuously since

This detail concerning title has been deemed necessary because of the confusion that sometimes arises between the titles Asiatic Society of Bengal and Royal Asiatic Society of Great Britain and Ireland, and because it is not always realised that the Asiatic Society of Bengal is the parent and older body

In his inaugural dissertation, Sir William Jones expounded the definition of the aims of the Society contained in the title of his address and his words have been paraphrased into: "The bounds of its investigations will be the geographical limits of Asia, and within these limits its enquiries will be extended to whatever is performed by Man or produced by Nature", and this sentence now serves as the motto of the Society.

At the second meeting of the Society it was decided to invite Warren Hastings, then Governor-General of India, to accept the office of president of the Society Hastings declined the honour on the grounds of his inability to devote sufficient attention to the work of the Society and for other reasons, and requested the permission of the Society to yield his pretensions to the gentleman whose genius planned the institution Following this suggestion, Sir William Jones was elected the first president and held office until his demise in 1794

The institution thus planned and founded has had a continuous existence down to the present and is still in active being In 1884 the Society celebrated the centenary of its foundation and published a centenary review volume, in which is a full account of the past century's work of the Society This volume contains first (Part I) a history of the Society, from which the foregoing details have been taken. Then comes in Part II a review of the literary activities of the Society, classified under archæology, history, literature, etc. From this section the reader will learn the outstanding part played by the Asiatic Society in the deciphering of inscriptions on stone and metal, (coins and pillars), and in texts on palm leaf and paper, and in the discovery of the clues to ancient scripts, with resultant contributions to the history of ancient India In this section outstanding names are Sir William Jones himself, Henry Thomas Colebrook (the founder of the Royal Asiatic Society), Horace Hayman Wilson (of the Medical Service of the East India Company, Assay Master of the Calcutta Mint and finally Boden professor of Sanskrit at Oxford), and James Prinsep (who succeeded Wilson as Assay Master)

Part III of the centenary volume summarises the researches in science published by the Society, classified under mathematical and physical sciences, including meteorology, geology, zoology, botany, geography, ethnology and chemistry Amongst researches to which reference may be made are the Venerable Archdeacon Pratt's views on the importance of allowing for Himalayan attraction in determining the curvature of the arc of the meridian in Hindustan, Capt J T Newbold's researches on the geology of Southern India, work on the correlation and classification of the Peninsular formations of India, particularly the researches of Thomas Oldham and W. T. Blanford, the work of Hugh Falconer and Proby Cautley and others upon the rich vertebrate fossil fauna of the Siwalik Hills, Brian Hodgson's studies of the bird and mammalian fauna of Nepal, Sikhim and Tibet, and the work of the "Indian Linnaeus", William Roxburgh, on the plants of the East A rich field was tilled by a number of workers on the ethnology of the numerous tribes of India.

In the early days of the Society, the East India Company, the predecessor of the Crown in India, had no organised scientific services, and the scope for such a society as the Asiatic Society in collecting, describing and classifying the natural history objects of India, particularly in the fields of geology, zoology, botany and ethnology was enormous; and the *Asiatic Researches*, the first publication of the Society, and the volumes of the *Journal of the Asiatic Society of Bengal*, contain a great number of papers on aspects of the natural history of India These activities led to the accumulation of a large quantity of specimens, in consequence of which the Asiatic Society was compelled to found its own museum Ultimately, the increasing volume of material proved too great a tax on the resources of the Society, and negotiations were opened with the Government of India, which terminated in the establishment of the present Indian Museum, in accordance with Article XVII of 1866 The collections of the Asiatic Society of Bengal were then entrusted to the Indian Museum, which is administered by a board of trustees on which the Asiatic Society of Bengal was, and still is, represented These collections were incorporated with the collections belonging to Government or made by Government departments, such as the Geological Survey of India, founded in 1851

The formation of several Government scientific services, such as the Geological Survey of India, the Indian Meteorological Department, and the Botanical Survey of India, the Zoological Survey of India, and the Agricultural Research Institute at Poona, each department with its own journal or journals, now diverts to the respective publications a large number of papers that would formerly have been presented to the Asiatic Society of Bengal In addition, the formation of specialist scientific societies, such as the Indian Chemical Society, the Indian Physical Society and the Mining and Geological Institute of India, affords an outlet for the papers of non-official workers in science, many of which in the past would have been offered to the Asiatic Society of Bengal. The consequence is that the number of papers in science offered to the Asiatic Society of Bengal has fallen during the fifty years now ending much below the figures of the past

The Society has not, however, lost its importance to science Apart from its historical rôle of parent and sponsor directly or indirectly of many of the scientific societies and Government scientific departments in India, the Society now undertakes the important duty of organising the Indian Science Congress Association, a body that plays in India a part analogous to that of the British Association in England, meeting annually in January at different centres in India The Society not only acts as organiser and office to the Indian Science Congress Association but also publishes the annual volume of *Proceedings* of the Congress meetings

In respect of science, therefore, the Asiatic Society of Bengal now plays the rôle of an 'elder body'. There is a general feeling that with the formation in India of an increasing number of specialist and local societies, and the resultant increasing tendency of sciences to work in isolation from one another, that a greater measure of co-ordination is required than is afforded by the annual meetings of the Indian Science Congress, the question of forming an Indian Academy of Sciences is consequently under discussion. One possible solution would be that the Asiatic Society of Bengal should occupy a position analogous to that of the Institute of France and become the parent body for not only an Indian Academy of Sciences, but also for an Indian Academy of Letters to represent the other side of the present activities of the Asiatic Society of Bengal and other groups of men of letters in India. Such a development, with perhaps a reversion of the title of the Society to "Asiatic Society" without the words "of Bengal", so as to remove the provincial sound, would seem to be the simplest solution to the problem and one that would well celebrate the hundred and fiftieth anniversary of the Asiatic Society, should this seem appropriate to the scientific workers of India as a whole. Such a development would also have the great advantage of preserving the liaison that still exists between science and letters in India.

Economics of Nutrition

THE Council of the British Medical Association, having realised that the adequate nutrition of the population is a matter of national importance, appointed a committee in April 1933 "to determine the minimum weekly expenditure on foodstuffs which must be incurred by families of varying size, if health and working capacity are to be maintained, and to construct specimen diets". The report of the committee was printed as a supplement to the *British Medical Journal* of November 25, 1933, which has now been reprinted.

The feature of the pamphlet is a series of sixteen carefully compiled diets suitable in quantity and variety for a single adult man, for children of various ages and families of different sizes. The quantities of the foodstuffs are calculated in accordance with the physiological standards and 'man value' of the families from Cathcart and Murray's figures. A family consisting of a man, a woman, and four children of the ages thirteen, ten, seven and four years, according to this standard has a man value of 4·63.

Stress is laid upon the kind of protein, whether it is of animal origin (first class), or of vegetable origin (second class). The infant's diet of milk consists of animal protein only, and it is advised that the change from the infant's to the adult diet be gradual, with the maintenance of a high proportion of animal protein, and be not completed until the child is three to five years of age. The amount of animal protein is maintained at a high level (60–75 per cent of the total protein) at any rate until school age is past, as shown in the specimen diets, and may be continued at this level so long as the child is growing. Unfortunately, the introduction of animal protein adds to the cost of the diet and is not always practicable. It is recommended that the supply of protein for the child be from cheese, fish and minced meat. We may refer to diet No. 4 proposed for a child of one to two years. It is based upon a minimum of 1 pint of milk daily, which is looked upon as the maximum expenditure which is likely to be possible on this article of food. The weekly quantities are: milk 7 pints, meat ¼ lb., fish ¼ lb.; butter ⅛ lb., flour 1 lb., oatmeal ¼ lb., sugar ⅛ lb., potatoes 1 lb.; ½ lb. each of cabbage, turnips, carrots and tinned tomatoes. In this diet the proportion of animal protein is 71 per cent of the total protein and the calorie value is 1006, the child of this age corresponding to a man value of 0·3.

Similar diets with proper first-class protein for older children of three to six years are given in Nos. 5 and 6. In diets Nos. 7 and 8, for children of six to ten years, the milk is reduced to ½ pint daily.

Diet No. 1 is an example of the bare ration without variety for an adult man and costs 58·25 pence weekly. With variety the cost is increased to 70·5 pence weekly. Diets 9–16 are family diets with one or more children of different ages, and the man cost of these diets is 76·1–66·5 pence weekly. The costs have been calculated from a special scale of prices ascertained by the British Medical Association. Another scale of lower prices gives those prevailing in Stockton.

So far as the diets are concerned, the variety and quantities are extraordinarily well chosen and could be universally adopted. We would earnestly recommend all schools and institutions to use these standards of quantities and regard them as the *minimum*, increasing the quantities of milk, meat, fish and egg if funds permit. Children would thus be given a fair start in life. There is at present a tendency in school diets to restrict the supply of first class protein to a level inconsistent with the demands of growth between the ages of fourteen and eighteen years.

A considerable proportion of the specimen diets consists of dairy produce, vegetables and fruits. The minerals of the diet are thus amply provided. The supply of vitamins, especially of A and D, and C is regarded as sufficient from the quantities of milk, butter, eggs, cheese, liver, fish and vegetables. It is pointed out that whole cereals, beans, peas and lentils are the source of vitamin B, but some of the diets do not contain any of these articles of food, and if included the weekly total of such foods is very small. No stress is laid upon the advantage of wholemeal bread in preference to white bread or flour, for the supply of the vitamin B group, and in respect of this vitamin the diets cannot be regarded as satisfactory.

A main criticism will always be the costs of the diets, which naturally vary greatly according to season and locality. It is not often that a palatable egg can be purchased for a penny. Cheese at 6d. per lb. is not everywhere procurable, and minced meat at 6d. per lb. is not likely to be of good quality, but consist mostly of gristle and fat. Still, the diets show that for a weekly expenditure of 5*s*.–6*s*. 6*d*., a man can procure a well-balanced diet.

The calorie value of these diets is based upon the daily consumption of an adult man, which has been assessed at 3000. Diet as consumed is not the same as diet as purchased since allowance has to be made for waste, such as bone in meat and fish, outer leaves of vegetables, etc. This waste is commonly reckoned at 10 per cent. The calorie values of the diets is given as 3400 as purchased. This gives a figure of 3060 as consumed. This does not thus vary appreciably from that adopted by the Ministry of Health following a report on dietary investigations of which an account was given in NATURE of June 13, 1931 (vol. 127, page 897). There is no doubt, however, that many families can exist upon a smaller calorie intake, down to 2500 calories, depending upon their manual work.

The allowance of first-class protein of 50 gm. a day appears to be a higher allowance than that of the Ministry of Health. The minimum quantity has been assessed at 37 gm. a day. The Army ration in peace time contains 62·7 gm. of first class protein. There can be no serious objection to taking the mean figure of 50 gm. a day, especially when a family including children is taken into consideration.

August Weismann, 1834-1914

THE name of August Weismann, the famous professor of zoology in the University of Freiburg-im-Breisgau, the centenary of whose birth falls on January 17, will always be remembered as that of one who exercised a profound influence on the progress of biological doctrine and speculation. As a teacher of zoology Weismann achieved a far-reaching reputation; and by the students who worked under his direction, among whom, it may be remembered, was the late Prof. Gilbert Bourne of Oxford, his instruction was estimated at the highest value. But it was as an investigator and explorer of the methods of evolution that his influence was most widely felt, especially perhaps in Great Britain.

It was Weismann who first detected the true significance in the development of the insect wing of the rudimentary larval structures noticed by previous observers. His work on the embryology of the Diptera, and especially of *Corethra*, led him to the recognition of the origin of the appendages of the adult insect in hypodermic downgrowths to which he gave the name of *Imaginalscheiben* (imaginal discs or folds). Linked with this came his discovery of the remarkable phenomenon of histolysis, which he supposed to be of more general occurrence than later observations have shown to be the case. The importance of Weismann's work in this department was early recognised by Darwin, who contributed a prefatory notice to the "Studies in the Theory of Descent". This was the book through which, owing to the good offices of Prof. Meldola, Weismann's biological theories were chiefly brought to the notice of men of science in Great Britain. To the "Studies" may be attributed the impulse which started Prof. E. B. Poulton on many of those lines of investigation which have led in his hands to such fruitful results.

The outstanding claim of Weismann to the attention of biologists, however, was his bold challenging of the supposed effect of Lamarckian factors in heredity. This view, at the time of its publication, was no less than revolutionary. The opposition that it aroused, at first strong and sustained, has never completely died down; at the present day, however, the votaries of Lamarckism are comparatively few in number. To this result the developments of Mendelism have contributed in no small degree, but the first effective attack on the transmission of somatic modifications was delivered by Weismann. His elaborate scheme of 'biophors', 'determinants' and 'ids' has not stood the test of later investigation; there is no doubt, however, that his postulate of 'determinants' foreshadows in many respects the present-day conception of 'genes'. Moreover, in his theory of intra-germinal selection, by which he sought to reconcile the old antagonism of preformation and epigenesis, he may be said to have anticipated in some measure the modern doctrine of the interaction of genetic factors in ontogeny.

Weismann was led in course of time to modify to some extent the somewhat exaggerated view that he took of the inaccessibility of the germ-plasm; but the distinction now generally drawn between the genotype and the phenotype is evidence of the virtual stability of the position first definitely established by him. It would be interesting to know, were it possible, what his attitude would be in face of the developments that have followed on Mendel's discovery of the segregation of the gametes.

Weismann, with his tall figure and pleasant demeanour, was a striking and attractive personality. He was not averse from discussing the relations between science and philosophy, though he was fully aware of the limitations that exist on both sides. His general position may be briefly summarised in his own words, translated by Meldola as follows: "The mechanical conception of Nature very well admits of being united with a teleological conception of the Universe."

F. A. D.

Obituary

SIR FREDERIC NATHAN, K B E

COLONEL SIR FREDERIC LEWIS NATHAN died on December 10 at the age of seventy-two years As a young artillery officer who had passed through the advanced class of the Ordnance College, Capt F L Nathan, as he was then, was detailed to take part in the experimental work of Abel, Dewar and Kellner, who were bringing out at Woolwich the smokeless propellant cordite He was thus at the birth of that explosive, to the improvement and manufacture of which he was to devote his energies between 1892 and 1909 at the Royal Gunpowder Factory, Waltham Abbey, as Assistant- and then as Superintendent During these years it can fairly be said that a new technique was introduced into the manufacture of explosives. The methods of Waltham Abbey were adopted by the then numerous private firms making explosives, while later the propellant factories erected during the War embodied the features of Waltham Abbey practice

The improvements made during this time included a reorganisation of the work of the factory, to which Sir Frederic devoted the energy of a logical and business mind, the invention and introduction of new processes of manufacture of cordite and its ingredients, the study of danger precautions in manufacture on which he became an authority, and the recognition of the importance of investigative work

Having raised the Royal Gunpowder Factory to the highest pitch of efficiency, Sir Frederic retired from the Army to apply his methods to the Nobel factory at Ardeer, of which he was works manager from 1909 until 1914, and in March 1915 he was appointed adviser to the Admiralty on cordite supply when he was given the task of designing and laying out the Royal Naval Cordite Factory at Holton Heath Here, on an open area, unencumbered by ancient water-ways and existing buildings as at Waltham Abbey, he had free scope to erect a magnificent propellant factory such as would embody his experience of process and study of precautions for safety, and in which there was orderly progress from raw to finished material This having been completed and put into operation, Sir Frederic became Director of Propellant Supplies under Lord Moulton

After the War Sir Frederic concerned himself for a time with the safety of explosives in coal-mines, and as a member of the Department of Scientific and Industrial Research he gave his attention to the possibilities of home-produced alcohol as a motor fuel, and later to fuel research, for which he was the Department's Intelligence Officer up to the date of his death In this capacity he applied himself to the extraction of what was relevant in the literature and to the best methods of indexing it He was also chairman of the Association of Special Libraries and Information Bureaux (A S L I.B), editor of a *British Power and Fuel Bulletin* issued by the World Power Conference, and projected at the time of his death the publication of an *International Power and Fuel Bulletin* in three languages, indexed according to the decimal classification of the Institut International de Bibliographie

Among other activities should be mentioned Sir Frederic's interest in the training of the chemical engineer, this being the title of his presidential address to the Institution of Chemical Engineers, of which he was one of the founders and twice president He was also Commandant of the Jewish Lads' Brigade for twenty-one years. He was knighted in 1906 and became K B E in 1918 Lady Nathan and three sons survive him. His third son was killed in action on June 14, 1917

Those who came into contact with Sir Frederic Nathan could not fail to recognise his high ideals, his great industry and his methodical mind, those who had the good fortune to work with him found in him an inspiration and constant support in the appreciation and furtherance of their scientific work ROBERT ROBERTSON

MR A E P WEIGALL

WE regret to record the death on January 2 at the age of fifty-three years of Mr Arthur Edward Pearse Weigall Mr Weigall was the son of Major A A D Weigall He matriculated as a member of the University of Oxford from New College in 1900, but after a brief residence joined Sir Flinders Petrie's staff for archæological exploration at Abydos in Egypt In 1905 he was appointed Inspector-General of Antiquities under the Egyptian Government, a post which he held until 1914 His archæological work was recognised by his appointment as officer of the orders of the Red Eagle (Germany), Franz Josef (Austria), and the Medjidieh (Egypt)

Weigall was a prolific and versatile writer, his work ranging from the record of archæological investigation to the purely imaginative effort of novel writing. His gifts were perhaps most happily displayed in the imaginative interpretation of archæological and historical data as in his "Life of Akhnaton, Pharaoh of Egypt" (1910) and "Life of Cleopatra, Queen of Egypt" (1914) Among his numerous archæological and historical works may be mentioned —"Abydos" (sections of) Parts 1 and 2 (1902 and 1904), "Report on the Antiquities of Lower Nubia" (1907) , "Catalogue of Weights and Balances in the Cairo Museum" (1908) , "A Guide to the Antiquities of Upper Egypt" (1910) ; "The Treasury of Ancient Egypt" (1911) , "Tutankhamen and other Essays" (1923) ; "A History of the Pharaohs" (1925–26) and with A H. Gardiner "Topographical Catalogue of the Private Tombs of Thebes" (1913) He was also the author of a book of travel, "Travels in the Upper Egyptian Deserts" (1909).

News and Views

The Loch Ness "Mystery"

SINCE a note appeared in NATURE regarding the alleged "monster" of Loch Ness (Dec. 16, 1933, p. 921) evidence has accumulated, on one hand, to warn the credulous against the suppositions of unskilled observers, and on the other to point to the identity of the creature which has caused so much commotion in the daily newspapers In the first place, the writer of these notes has examined, through the kindness of the Associated Press, the original negative, said to be a direct photograph of the Loch Ness "monster", from which prints appeared in various newspapers about December 6 and 7. Regarding this photograph, it is not necessary to say more than that the object appears not to have been photographed at the distance stated, 200 yards, and that in the writer's opinion the object represents no animal known to science In the second place, the "spoor" of the animal, about which fantastic tales were spread, has, according to the *Morning Post*, led the authorities in the British Museum (Natural History) to conclusions decidedly unfavourable to some of the expectations previously aroused No support was found in this evidence of the 'monstrousness' of the monster

As to the other side of the story , in the *Scotsman* of January 1, appeared a sketch made by an observer, and on January 6, the *Aberdeen Press and Journal* published a sketch made by a final year veterinary student who saw the creature on land by the Loch side, by the light of the moon and of his motor cycle lamp, who, somewhat boldly it would seem, upon his knowledge of natural history and prehistoric animals, stated his opinion that it was "a cross between a seal and a plesiosaurus" But the sketch and the description of the beast and its movements are more reliable than the identification Without analysing these in detail, for they are wonderfully accurate considering the physical light and the mental atmosphere which surrounded the creature, one can have little doubt that the object figured in the *Scotsman* and seen and sketched by Mr A Grant in the early morning of January 5, was a large grey seal. The species occurs not infrequently in the Moray Firth, whence it probably comes from its nearest breeding grounds in the Orkney Islands , it is the common species of the western isles of Scotland

Exhibition of British Art

THE winter exhibition at the Royal Academy is devoted this year to British art and it was opened to the public on January 6. The first president of the Academy, Sir Joshua Reynolds, whose dignified statue by Mr Alfred Drury, R A , stands in the courtyard before the entrance to the Royal Academy at Burlington House, once said . "Variety reanimates the attention, which is apt to languish under continual sameness". There is certainly no lack of variety in this exhibition Sir Joshua was one of the earliest to make scientific experiments as to the effect of light and atmosphere upon the permanence of pigments. Since his day the chemist and physicist have given much attention to this subject, with the result that modern paintings, as well as showing great brilliance, undoubtedly possess that lasting quality which is so desirable. No. 568 in Gallery IX is a striking example, and if the rainbow is a little too solid-looking, it at least has the merit of having the colours in the right order. The greater permanence under suitable conditions of water colours, which of course do not suffer from the darkening of varnishes or media used in oil paintings, is a feature of the exhibition, and attention may be directed in this respect to No 801, by Rowlandson, and especially to the beautiful work of Cotman, Turner and others In the Architectural Room may be seen a case containing thirty-five watches all made in England between the years 1583 and 1751

Symbolism in Art

AT the Friday evening discourse delivered at the Royal Institution on November 17, the audience had the unusual, but instructive, experience of hearing, in Sir Herbert Baker's account of "Symbolism in Art", a distinguished practitioner of this form of expression in architecture on his principles, not from the æsthetic, but from the historico-scientific point of view The discourse is now available in printed form The interpretation of symbols, which is an element of no little importance in the study of art and the history of religions, suffers in a large number of instances from the drawback that it must be a matter of inference, and sometimes merely guesswork Sir Herbert, in demonstrating to his audience the ideas which inspired, for example, the choice of motifs and subjects in the design of arms for the provinces of India used in the decoration of the new Delhi, showed the methods of the symbolising mind, first seeking the characteristic quality or incident pertinent to its subject, then giving it concrete form—thus, for example, selecting for the arms of the United Provinces the meeting of the sacred rivers at Allahabad, the bow of Rama, whose capital was at Oudh, and the fishes, the emblem of world power of the old Nawabs of Lucknow. Should events confirm Sir Herbert's diagnosis of the present trend of development in art towards symbolism, as the place of representational art is taken by mechanical means of reproduction, clearly the historical study of these principles and methods of symbolic art, of which he deplored the lack in the early part of his discourse, will demand increasing attention

SIR HERBERT BAKER treated his subject-matter under two heads, touching first on early historical phases of symbolism and then describing attempts which he and collaborating artists have made to embody in the medium of art some facts of human experience As already indicated, it is the personal experience upon which the latter part of the discourse was based, which gave weight to the view of symbolism taken in the introductory historical sketch. Here Sir Herbert took the lightning flash and the thunderbolt as the first expression by early man in his 'rude art' of the symbolism of divine power. The gods depicted by man held the symbol of the thunderbolt first as a weapon, later as a baton or sceptre of authority. In that form, Sir Herbert pointed out, it is a widespread symbol in all primitive art. It occurs among Minoans, Greeks, Romans, the Hittites, in Mesopotamia, Central Asia, India and Mexico. The bolt was traced, with the addition of the wings of Jove, as it developed into the trident of Poseidon and Britannia and the lily of France. Two interesting examples of misinterpretation were quoted, which are not without a moral for those who practise interpretation of symbols: first, Napoleon mistook the *fleur de-lys* of Clovis for bees and changed the *fleur de lys* in his own arms and those of Paris to representations of that insect; secondly, the Belgians took the flower on the French soldiers' uniform for representations of the frog and christened the French *crapauds* accordingly.

Sounding the Ionosphere

Prof. E. V. Appleton showed in our columns in 1931 the importance of determining the variation, with frequency, of the equivalent path traversed by wireless signals returned from the ionosphere, since such determinations measure the maximum density of ionisation in the regions sounded. The letter from Mr. R. Naismith which we publish in our correspondence columns this week describes work which he carried out in May 1933. We understand that publication was deferred in accordance with an agreement between British and German workers that none of the results of radio work within the programme of the Second International Polar Year should be published until after the end of that year. The letter directs attention to the need for a rapid and more or less completely automatic method for recording the relation between the radio frequency of the pulse signals used and the equivalent path traversed by them in their double journey to and from the ionosphere, at nearly vertical incidence. At the time when the work described was carried out, there were available several methods for the continuous automatic recording of equivalent path against time of day, for a single frequency, but not for the more difficult problem of recording path against frequency.

The radio staff at the U.S. Bureau of Standards has been working on the same problem, and at the annual convention of the Institute of Radio Engineers at Chicago on June 27, 1933, Mr. T. R. Gilliland (*Bur. Stds. Jour. Research*, Oct. 1933) described an automatic recording system giving records of the required type over the frequency range of 2500–4400 kc./s., the frequency being varied at the uniform rate of 200 kc./s. per minute so that the full range was covered in about ten minutes. The closeness of dates between the American and British work is illustrated by the fact that Mr. Gilliland showed a record for April 22, 1933, while Mr. Naismith shows one for June 6 and informs us that his first record was taken on May 20. The means of investigation thus made available is clearly a very powerful one, and geophysicists will look forward to the results of the further developments promised from the Bureau of Standards and the National Physical Laboratory.

Yorkshire Scientific Magazines

The publication of the December issue of the *Naturalist*, the monthly journal of the Yorkshire Naturalists' Union, completes a hundred years of the regular publication of this scientific magazine. The *Naturalist* originally appeared under the title of the *Field Naturalist* as an octavo monthly of 48 pages in January 1833, under the editorship of Mr. James Rennie. It ran for fourteen issues and then appeared under the title of the *Naturalist*, edited by Mr. Neville Wood, of Doncaster. In 1851 the second series of the *Naturalist* commenced under the editorship of Beverley R. Morris, and later the Rev. F. O. Morris, author of the well-known "History of British Birds", the third series, edited by C. P. Hobkirk, appeared from Huddersfield in 1864. The fourth series of this magazine were edited by Joseph Wainwright and appeared from Huddersfield under the changed title of the *Yorkshire Naturalists' Recorder*, but the fifth series, in August 1865, reverted to the present title, the *Naturalist* (Sheppard, "Yorkshire's Contribution to Scientific Literature", *Naturalist*, 1915). The fifth series, edited by Messrs. C. P. Hobkirk and G. T. Porritt, was issued at Pontefract, but later transferred to Leeds under the editorship of W. D. Roebuck and W. Eagle Clark, in 1884. In 1889, W. Eagle Clark, leaving for Edinburgh Museum, vacated his editorial post and Roebuck continued to be editor until 1912, assisted by E. R. Wade in 1892. In 1902 the *Naturalist* was issued from Hull under the editorship of T. Sheppard, assisted by Dr. T. W. Woodward. Mr. Sheppard relinquished the editorship in 1932. He was succeeded in 1933 by Dr. W. E. Pearsall and W. R. Grist as editors, when the *Naturalist* once more was issued from Leeds.

Few counties have such an interesting record of scientific journalism as Yorkshire, and the *Naturalist* has watched many contemporary magazines rise and fall in its century. The *Bradford Scientific Journal* and the *Halifax Naturalist* were contemporary magazines. The *Circular* appeared as a scientific monthly in Halifax, 1866, while the *Practical Naturalist* commenced in Bradford in 1883 and was continued at Ilkely. The *Naturalists' World* was another of Ilkely's scientific monthlies and in 1879 the *Young Naturalist* appeared from Hartlepool and Huddersfield, becoming the *British Naturalist* in 1891, but ceasing issue in 1894. From 1882 until 1883, the *Naturalists' Monthly* was issued from Bradford and in 1892, the *Naturalists' Journal* commenced, later becoming *Nature Study* and being issued from Huddersfield, where it ceased publication in 1905. The *New Nature Study* commenced at Huddersfield in 1912 but was short lived. The Malton Field Naturalists' Society issued a monthly journal, *Naturalists' Notes*, at the end of last century, while the *Natural History Journal* was published at York from 1877 until 1898 A contemporary, the *Naturalist*, but with no connexion with the present journal of that name, appeared monthly in York in 1834, mainly for school nature students

Conference of Educational Associations

THE twenty-second annual Conference of Educational Associations was held at University College, London, on January 1–8 Dr George Dyson, of Winchester College, in his presidential address on "Education for Life", said that though there is a great and growing interest in music and the arts, it is still true that the writing of poems, the making of pictures, the modelling of statues, the playing of sonatas, the composition of songs, are regarded as frills Our education is a system of mental education, training only a fraction of human faculty and character He recommended a system of differentiated secondary schools, one type being frankly a workshop

THE Great Hall was crowded on January 4 for a discussion on "The Failure of Modern Science to develop an Adequate Cultural Background to Life" Dr W W Vaughan presided and the discussion was opened by Prof Julian Huxley, who said that the defects of scientific education are over specialisation, the failure to link science to other studies and over-emphasis on physics and chemistry, as against biology and related subjects There is a tendency to devote too much time to practical work He considers that science should be studied as an integral part of history and that more attention should be given to applied science, the aims of science teaching being a coherent general outlook in which scientific ideas are integrated, and the inculcation of the scientific method in human affairs Sir Arnold Wilson's contribution to the discussion showed that he favours the teaching of science in elementary schools, in which he thinks there should be great development, and he stressed the ethical aspect of science teaching and its hope of bringing inspiration, strength and inward peace to mankind and stability to civilisation The subsequent discussion elicited several useful suggestions, one being that young and rapidly developing branches of science might be considered from the viewpoint of their educational value. Several speakers referred to the importance of personal influences, the use of leisure, and emotional life and experience as contributing to 'cultural background'

Association of British Zoologists

THE annual meeting of the Association of British Zoologists was held in the rooms of the Zoological Society in Regent's Park on January 6 On previous occasions the Association has been interested in the provision of revision classes in biology at the universities for school teachers. Dr F A Dixey reported the work which the Council of the Association has done in the past year on this subject Classes are now provided at several universities and have been well attended In view of the expansion in the teaching of biology in schools which is now taking place, the subject is recognised as important, and the Council was asked to continue its activities. Mrs. M D Brindley, opened a discussion on the possibility of providing some means by which information concerning the British fauna could be made more easily and rapidly accessible The preservation of the fauna among the rapid and widespread changes which are bound to occur in a thickly populated country is difficult, but it is a task in which zoologists must always be interested Changes in the fauna are often of importance to the community At present a very large amount of information on the natural history of the fauna has been collected but much of it is scattered through many, often obscure, journals

PROF D M S WATSON gave his views of the scope of the teaching which should be carried on in a university department of zoology In order that the student may be able to deal later with the biological problems which will be the subject of his investigations, his teaching should be broad and should be concerned as much with the natural history and physiology of animals as with their structure Prof Watson gave an account of the way in which these views have been expressed in the design of the buildings which have recently been built for his department at University College. Some problems of zoological technique were also discussed Prof H G. Cannon gave a lecture on the technique of making drawings for the illustration of zoological papers. It is hoped that the Council will be able to publish his lecture

Ninth International Congress of Pure and Applied Chemistry

SPAIN will act as host for the ninth International Congress of Pure and Applied Chemistry, which will be held in Madrid on April 5 11, 1934, under the patronage of H E the President of the Spanish Republic and of the Spanish Government. The object of the Congress, which was to have been held in 1932, is to promote the progress of pure and applied chemistry, and to strengthen relations between chemists throughout the world The president of the bureau of the Congress is Prof Obdulio Fernández, and the general secretary is Prof Enrique Moles, the address of the organising committee's office is San Bernardo 49 (P O Box 8043), Madrid (8) Membership is of three categories · honorary members, comprising the committees of honour and of patronage, and the official delegates of the Spanish Government and of the governments of other countries, supporting members, who pay the minimum amount of 300 pesetas; and active members, who pay a fee of 75 pesetas (about £1 17*s* 6*d*) Members' ladies pay 25 pesetas only, but they will not be entitled, as members are, to receive publications *in extenso*, the daily bulletin, summaries of communications, or the report of proceedings Membership is open to societies, institutions, etc , connected with any branch of pure or applied chemistry, and to individuals interested therein Applications for membership should be made to the general secretary before February 15, 1934, and should be accompanied by a remittance made payable to the treasurer. Pamphlets containing the rules of the Congress and other information can be obtained in England from Mr S E Carr, The Chemical Society, Burlington House, Piccadilly, London, W 1.

GROUPS and sections of the ninth International Congress of Pure and Applied Chemistry have been organised as follows: (1) Physical and Theoretical Chemistry, pure (electrochemistry, photochemistry), applied (colloid chemistry, rubber, tanning and leather materials, electrometallurgy), (2) Inorganic Chemistry, pure, applied (glass, ceramics, cement, mineralogy, metallurgy), (3) Organic Chemistry, pure, applied (colouring materials, explosives, sugars, starches, cellulose, paper, fats, oils, soaps, colours, paints, varnishes); (4) Biological Chemistry, pure, applied (medical and pharmaceutical chemistry, fermentation industries), (5) Analytical Chemistry, pure, applied, (6) Agricultural Chemistry, (7) History and Teaching of Chemistry, Economics and Chemical Legislation. Papers may be in the language with which the author is familiar, but the organising committee suggests the use of such languages as will avoid typographical difficulties when rendered into Latin type Summaries must be given in English, French, German, Italian or Spanish Scientific communications intended for the Congress should be forwarded by February 5, 1934 The Congress will comprise general lectures, lectures, followed by discussions, in the various groups, and original communications. The general lectures will deal with mineral chemistry, organic chemistry and biochemistry

Metric System in China and Turkey

ON December 1 of last year, the Chinese Government issued a notice to the effect that the metric system of weights and measures would be introduced into the Customs service on February 1 According to the Shanghai correspondent of the *Times*, the metric system has been applied in the collection of the salt tax since January 1 On the same date, Turkey adopted metric weights and measures, and that system is now obligatory throughout Turkish dominions in Europe and Asia. Thus Turkey, until recently one of the most backward of the European powers, has come into line with the majority of modern States, and no doubt her commerce and industry will benefit from the consequent simplification Several attempts have, of course, been made to introduce decimal weights, measures and coinage into Great Britain, but the most that has been achieved is the legalisation of the use of metric weights and measures, and the adoption of such terms as 'metric ton'. It would seem that the fuller use of the metric system in Great Britain, like the introduction of the 24-hour clock, is unduly delayed by the prevalent inertia of unscientific public opinion

Non-Reflecting Windows

NON-REFLECTING windows are beginning to be used for shops. The reflectionless window is a British invention It is made of a concave sheet of glass so constructed that the light from all sources incident on it is reflected to two black boards arranged one at the top and one at the bottom of the glass The eye of the observer looking at the glass from in front is completely unaffected by any of the reflected light, the result being that it is very difficult to believe that there is any glass between the objects displayed and the observer The prospective buyer therefore views the goods more clearly and is not distracted by images It is also claimed that the reflectionless window effects an appreciable saving in the cost of artificiable lighting, since every lamp in use is able to give its full illuminating value and has not to compete with the disturbing effects of outside rays reflected by the window The new window is applicable to all shops whether new or old, and for maintenance it costs no more than an ordinary plate-glass window An illustrated description of the reflectionless window is given in the *Illuminating Engineer* of January, 1934

Expedition to East Africa

AN important expedition for archæological and geological exploration of the Northern Frontier Province of Kenya Colony left England on January 4 Its purpose is to carry out a topographical and geological survey in the neighbourhood of Lake Rudolph in the great Rift Valley of East Africa Particular attention will be given to the search for evidence of an archæological or palæontological nature bearing upon the problem of the antiquity of man in the area, in the hope of extending further northward knowledge supplementing the discoveries made by Dr. L S B Leakey in Kenya and Tanganyika The personnel of the expedition will include two surveyors, Mr R C Wakefield of the Sudan Survey and Mr W H R Martin of the University of Oxford Mr D G MacInnes will be responsible for mammalian palæontology, and Mr J F Millard will act as archæologist Dr W Dyson, medical officer of the expedition, will collect zoological specimens and Mr V E Fuchs, who is the leader, is in charge of geology The work of the expedition, which is supported by a number of learned societies, including the Royal Society, the Royal Geographical Society and the British Association, is planned to occupy about a year

Overhead Line Distribution Outside Great Britain

AT the meeting of the Overhead-Lines Association in London on September 20, the methods used in North America and Scandinavia for distributing overhead lines were discussed. Mr A. L. Stanton, president of the Association, said that it is difficult to make comparisons between the methods used in different countries, as the everyday conditions vary widely In the United States, not more than five per cent of the street lighting is done by gas and not more than 25 per cent of the factory supplies comes from independent stations. The early development of many American supply systems was governed mainly by utilitarian considerations, not much attention being paid to securing continuous service, voltage regulation and avoidance of danger risks.

Mr. T. Stevens described the development of electricity supply in the rural districts of Sweden, Denmark and Norway. Sweden is divided into fifteen areas for the supply of electricity and in most of these the State gives the supply, the remainder being in general owned by a municipality. In the co-operative distribution associations in Sweden, consumers have to hold shares proportional to the acreage of their farms or the number of rooms in their dwelling houses. A certain length of cable is allowed free of charge. When only small supplies are taken, the tariff is greater. Denmark exports to southern Sweden steam-electric power at the times when the water supply is insufficient, and Sweden reciprocates when necessary. In recent years the supply from Sweden has increased from 20 to 90 million kilowatt hours a year. Sweden has 2,387 hydro electric plants. There are three submarine power lines connecting the two countries.

Phosphates in Sugar Fermentation

In his second Liversidge Research Lecture before the Royal Society of New South Wales, Prof. W. J. Young discussed the "Functions of Phosphates in Fermentations of Sugar". Although the production of alcoholic liquors by the fermentation of sugar is older than recorded history, it was only in 1837 that the suggestion was made that the change is due to the living organism yeast. The final proof of this was the work of Pasteur, who showed that the conversion of sugar into alcohol and carbonic acid is a physiological action of the yeast cell. Later on, Buchner discovered that the active principle, or enzyme as it is now called, can be separated from the living cell and will still carry on the action after such separation. Further work has shown that fermentation is a series of chemical reactions in which phosphoric acid plays a part, and during the process compounds between the sugar and phosphoric acid, termed hexosephosphates, are formed. Phosphates play a similar rôle in other biological processes in which sugars are decomposed to simpler compounds, as, for example, in the animal during muscular activity. During muscular work the animal uses up carbohydrate as a source of energy and this is changed to lactic acid, a process which requires no oxygen. Thus an animal can do a certain amount of work without requiring oxygen, as, for example, in a short sprint race. Oxygen is required later on to remove the lactic acid, hence one goes on panting after the effort is over. Fermentation in yeast and lactic acid production in the animal are thus similar changes, the sugar being decomposed through the same intermediate compounds to alcohol and carbonic acid in the former, and to lactic acid in the latter, and for both phosphates are necessary, and the same sugar phosphates are produced.

Work of the National Institute of Industrial Psychology

The *Human Factor*, 7, No. 12, presents the thirteenth annual report on the work of the National Institute of Industrial Psychology. The wide range of subjects dealt with by the Institute is very striking. The report gives brief indications of the work that has been done in factories, school buildings, retail stores, offices and even gold mines and tea and rubber plantations. The underlying problems of lay-out, 'processing' and personnel, etc., appear to have a certain similarity despite the diverse environments in which they are found. In the Research Section of the report, several interesting investigations are worthy of note. Mr. Harding's work on rhythm in occupational movements has thrown open new possibilities in relation to training schemes and the elimination of fluctuations in the speed of work in various occupations; its application to industry in general may be expected to produce far-reaching results. The nature and measurement of the mental abilities involved in factory assembly operations has been studied, and a colour-discrimination test is now ready for use. In addition, various occupational analyses have been undertaken, and the work on vocational and educational guidance has been maintained and extended.

Uses of Rubber in the Home

We have received an interesting and well-illustrated reprint from the *Furnishing Trades Organiser* on "Rubber Flooring and Furnishings". Rubber flooring has been improved both as regards quality and design and the price has come down substantially. The latest type of sponge upholstery is made direct from rubber latex. It is moulded in one piece and obviates the necessity for built-up construction. Sofas, chairs, mattresses and loose cushions are now made of rubber and are stated to be practically everlasting. Lists of companies manufacturing these products are given in the reprint, which is issued by the Rubber Growers' Association (Inc.), 2, 3 and 4 Idol Lane, Eastcheap, London, E.C.3.

Coloration of Fossil Bones

In the September number of *Revue Scientifique* occurs the last of a series of articles upon the coloration of bones which have been for longer or shorter periods buried in the ground. In the present article, L. Franchet deals with the effects upon bones of the boiling of a corpse, and the various colour changes due to incineration. The articles, in which the author discusses experiments he has made to check the effects which occur naturally, should be of value especially to archæologists and prehistorians, particularly in warning against rash deductions regarding the age of buried bones, derived solely from the condition of the bones.

Crystal Structure Models

In the October issue of the *Review of Scientific Instruments*, Mr. G. Glockler, of the University of Minnesota, describes a convenient form of model of crystal structure. The atoms are represented by black, white or coloured dots on vertical sheets of 'Cellophane', which are hinged along their bottom edges to a thin sheet of wood or cardboard and can be folded down for packing. When so folded, each model is about the size of a volume of NATURE.

Standards for Surgical Dressings

THE Pharmaceutical Society of Great Britain has issued a report on "Dressings" by a sub-committee of the Codex Revision Committee (Pharmaceutical Press, 23 Bloomsbury Square, London, W.C.1. 1s. 6d.). It contains a summary of standards for surgical dressings, provisionally accepted for inclusion in the British Pharmaceutical Codex, 1934, which should provide information useful for manufacturers and others. The standards suggested include those for the basic materials, such as jute, silk and wool, and for dressings such as phenol and mercuric chloride gauzes, and others, as well as methods for the determination of moisture, water extract, foreign matter, cotton and wool in the dressings.

Benefits to Animals from Animal Experiments

THE autumn issue of the *Fight Against Disease*, the quarterly journal of the Research Defence Society, contains the concluding portion of Sir Leonard Rogers' Stephen Paget Memorial Lecture. After a survey of some of the principal animal and virus diseases, Sir Leonard concludes that "the examples given from the limited field of tropical medical and veterinary science alone, suffice to prove that the reduction in the suffering that results year by year to animals, as well as to man, from the discoveries made in about three decades through a limited number of animal experiments, is incalculably greater than the pain inflicted on the animals under our humane laws".

Leverhulme Research Fellowships

APPLICATIONS are now invited for Leverhulme research fellowships for 1934. These fellowships are intended in the first instance for the assistance of experienced workers rather than to add to the provision already existing for workers in the early stages of their careers. It has been decided that no definite limit shall be placed to the amount of individual grants, but that they will be adjusted according to the circumstances of each particular case. Fellows will usually be required to work at, or in connexion with, a recognised centre of research, either at home or abroad. No subject of inquiry is excluded from the scope of the scheme. Awards will not be made, as a rule, for a shorter period than three months or for a longer period than two years. The closing date for receipt of applications is March 1. The awards will be announced in July and will date from September 1. All applicants must be British-born and they must also be normally resident in the United Kingdom. Further information can be obtained from Dr. L. Haden Guest, Secretary, Leverhulme Research Fellowships, Union House, St. Martins-le-Grand, London, E.C.1.

Announcements

DR. L. W. G. MALCOLM, conservator of the Wellcome Historical Medical Museum, has been appointed an officer of the Venerable Order of the Hospital of St. John of Jerusalem.

THE following appointments in the Colonial Agricultural Service have recently been made: Dr. F. J. Martin, assistant director of agriculture, Sierra Leone, to be director of agriculture, Sierra Leone; R. S. Ball and J. T. Moon to be agricultural officers, Kenya.

AT the ordinary meeting of the Institution of Electrical Engineers to be held on January 18, at 6 p.m., Viscount Falmouth will present to the Institution a copy of Sir William Orpen's painting of Sir Charles Parsons.

A JOINT meeting of the Royal Astronomical Society and the Geological Society will be held in the rooms of the Royal Astronomical Society, Burlington House, W.1, on January 26, at 4.30 p.m., when a discussion will be held on the "Origin of the Earth's Major Surface Features". The meeting will be presided over by Sir Frank Dyson.

THE annual meeting of the International Society of Medical Hydrology is to be held on January 28–February 2 at Zurich, Davos and St. Moritz. The president elect is Prof. O. Veraguth, professor of physical therapy in the University of Zurich. The principal subjects for discussion are the thermal bath reaction and the physiological and therapeutic effects of high mountain climates. Decisions will be taken concerning the nomenclature and classification of muds, peats, etc., used in physical medicine. The meeting is open to scientific workers generally as well as medical men. Further information can be obtained from the General Secretary, I.S.M.H., 109 Kingsway, W.C.2.

WE have received the 1934 pocket diary of Messrs. John G. Stein and Co., Ltd., silica and firebrick manufacturers, of Bonnybridge, Scotland. The diary contains many features of interest, for example, chemical analysis of various types of firebrick; special refractories, their analyses, expansion curves, thermal properties, etc.; equilibrium diagram of the system $Al_2O_3 - SiO_2$ (Bowen and Greig), first aid treatment; standards of measurement, and their equivalents, sectional road maps of Great Britain, and much other useful standard information.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An examiner in the aeronautical Inspection Department of the Air Ministry—The Secretary (S.2), Air Ministry (Jan. 15). A maintenance and test engineer in the Public Works Department, Electricity Branch, Government of the Punjab—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Feb. 1). A demonstrator in dairy husbandry and an advisory entomologist in the Department of Agriculture, University of Leeds—The Registrar (Feb. 2). A head of the Departments of Municipal Engineering in the Manchester Municipal College of Technology—The Registrar (Feb. 5). An agricultural chemist and an entomologist at the Imperial Institute of Agricultural Research, Pusa—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Feb. 12).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Refraction of Ionised Media

IN a recent letter Prof. Hartree[1] has directed attention to certain difficulties in the theory of refraction as applied to ionised media, and has criticised previous letters by Tonks[2] on the subject. I have myself been occupied for some time in trying to clear up this matter, and can confirm Hartree's opinion of the subtlety of the subject, but at the same time it should be said that, in spite of the defective proof, Tonks's result is certainly right. The problem is whether the formula of Sellmeier or that of Lorentz should be applied for a gas composed of free electrons moving among ionised atoms, which may be taken as fixed protons without losing the point of the question. The refractive index n is to be derived from atomic characters, and the problem is whether it is

$$S = n^2 - 1, \qquad (1)$$

or

$$L = 3(n^2 - 1)/(n^2 + 2) \qquad (2)$$

which is directly related to these. The alternatives for the ionosphere are whether it is S or L that is equated to

$$-Ne^2/\pi m v^2 \qquad (3)$$

where N is the number of electrons per c.c., v the frequency of incident waves, and e and m, the charge and mass of the electron respectively. If the formulæ are used to estimate the actual electron density of the ionosphere, there is a discrepancy of 50 per cent according to which of them is adopted, so that the question is by no means trivial. The same problem arises with even greater force in connexion with the optics of metals. It has been discussed by Kronig and Groenewold[3], their defence of the use of S is open to exactly the same criticism as that of Tonks, but from the known values of the optical constants of metals it is here even more certain that S is the correct form.

The essential point of the question consists in making the correct allowance for the mutual forces between the various particles concerned in scattering the light. The question is one in which we do not anticipate any great difference between classical and quantum theory, and it is easier to work with the classical; in the quantum theory of metals it has been usual to consider what is in effect only a single electron, and this cannot possibly throw any light on the present question. The main difficulty lies in estimating the large influence on each electron of its close neighbours, both protons and electrons. Tonks tries to overcome this difficulty by replacing the protons by a uniform distribution of positive charge-density, but this replacement is the crucial point of the problem; it is only done by an illegitimate inversion of the order of integrations, and this inversion leads to a large change in the resulting value. Unrigorous processes, like the inversion of integrations, are so habitually done in physics with impunity, that one is apt to trust them completely; with an unrigorous formulation of the present problem it is easy to find entirely plausible arguments leading either towards L or S. It is quite easy to show that a set of electrons moving in a uniform positive medium will obey a formula in S, and everyone agrees on this; the whole difficulty is to justify the replacement of the protons by the continuum, for there is little resemblance between the smooth motion of an electron in the continuum, and the zigzag path among the protons.

The technical problem of discussing with rigour the optics of a finite volume of any material is formidable, for it demands retarded potentials for the mutual forces of each pair of electrons, and so the system cannot be taken as a self-contained dynamical system, but must be treated with the help of Lorentz's device of making a fictitious spherical cavity round each electron. Most of the difficulty can, however, be avoided by the device of taking a small isolated sphere of the material and calculating the light it will scatter to a distance. If the radius a is much smaller than the wave-length of the incident light, there is no need to allow for retardation and the whole sphere can be regarded as a single dynamical system. A simple optical calculation shows that under incident light of amplitude A, it scatters light as though having electric moment

$$A\,a^3\,(n^2 - 1)/(n^2 + 2),$$

and therefore n is found if we can calculate the moment directly. For a set of separate elastically bound electrons, as in neutral atoms, there results at once a formula in L; at the opposite extreme, with a continuum of positive electricity, an equation is easily formed for the electric moment which leads to a formula in S. The important question is how the moment behaves for a set of discrete protons lying arbitrarily throughout the sphere. This is not the place to discuss details, but it can be seen that the average motion will satisfy the same equation as in the case of a continuum, provided that each electron undergoes many collisions during the period of the light. This condition is satisfied in the ionosphere for the long waves used, and in metals for ordinary light, so that S is the right expression in these cases.

As a general comment, it seems natural that S rather than L should be the more fundamental formula. Lorentz derived L by introducing a spherical cavity that was quite fictitious, and yet the algebraic form of (2) shows clear evidence of a real sphere. The reason is that there is a genuine sphere (or perhaps some other shape arbitrarily orientated) round each molecule; this is its own surface which prevents the entry of other molecules, and it is the existence of this small real sphere, and not the comparatively large fictitious sphere of Lorentz, that is responsible for (2). S is the natural formula for pure electromagnetic systems, and L is an expression of the fact that the systems to which it applies are governed by a law that is not electromagnetic—the exclusion principle which prevents one atom from penetrating another.

C. G. DARWIN.

The University,
Edinburgh.
Dec. 28.

[1] NATURE, 132, 929, Dec. 16, 1933.

[2] NATURE, 132, 101, July 15, and 710, Nov. 4. See also a letter by Norton, *ibid.*, p. 676, which seems open to the same criticisms, though his method is not very fully described.

[3] *Proc. Amst. Akad.*, 35, 974, 1932.

A New Hard Component of the Cosmic Ultra-Radiation

THE Steinke apparatus, which recorded the ionisation caused by the cosmic ultra-radiation at Abisko in northern Sweden during the polar year 1932–33[1], was moved in the middle of July to the iron ore mine Kirunavaara, near Kiruna, in order to record the absorption curve of the cosmic ultra-radiation below various thicknesses of iron ore. The Kirunavaara mountain is pierced at different levels by numerous galleries with rail tracks, some of which follow the ore body through its whole length (4 km.). It was therefore possible to move the apparatus, placed on a wagon or trolley, below layers of pure iron ore of different thickness from 160 to 10 metres, corresponding to water equivalents of 800–50 metres (the specific gravity of the ore being 5). Above the ore is only the atmosphere.

During three weeks in July there were holidays in the mines, and the management kindly lent me an electric train for the investigation of the cosmic ultra-radiation in the main galleries of the Kirunavaara mountain. The apparatus and a lead shield of 10 cm. thickness were assembled in a wagon and kept at constant temperature, and the wagon was moved below thicknesses of 107–60 metres of ore. It immediately appeared, however, that the ore sends out an unexpected and rather strong penetrating radiation; later investigation showed that the ore in this gallery had a radium content up to 0·05 mgm. per ton. (So far as I have been able to find from the literature accessible to me, this is the first time that radium has been found in iron ore.) Also the air in the gallery was highly radioactive and increased the ionisation within a 10 cm. lead shield to values which were impossibly high for the cosmic ultra-radiation. Nevertheless, if these values were reduced to their equivalent in radium radiation (which was taken up without shield), they showed an increase with decreasing thickness of the ore, and this increase indicated an absorption coefficient of the cosmic ultra-radiation about ten times less than that of the hardest component found by E. Regener[2]. At the beginning of August, V. F. Hess, W. Kolhorster, E. Regener and E. Steinke were privately informed about this result.

In order to eliminate the radium radiation, especially that from the air, special precautions and arrangements were necessary for the following measurements. A large airtight iron box of the dimensions 120 cm. × 80 cm. × 85 cm. was constructed containing two chambers, one above the other. This box was placed upon a trolley and in the lower chamber the ionisation cylinder of the Steinke apparatus was placed within a lead shield of 20 cm. thickness open upwards. Before the microscope was a window, and the photographic recorder was placed outside the box before this window. The airtight floor of the upper chamber was laid directly upon the lead shield, and upon this floor the upper lead shield of 10 or 20 cm. thickness was placed. Also the upper chamber could be made airtight. At the request of the management of the mines, measurements of the radium radiation were also carried out, and therefore the ionisation was recorded both with the shield open above (that is, with no shield in the upper chamber) and with shields of 10 cm. and 20 cm. above. During a month and a half, seven series of measurements were taken below 13–104 metres of ore; one series was taken without a shield in the upper chamber in order to get the radium radiation. The apparatus stood generally twenty-two hours at every place in every series and recorded the ionisation during every hour.

As might have been expected with respect to the radioactive air enclosed in the box, the values decreased steadily until the last two series, but the differences between daily values and the corresponding values of the last series were found to fit closely to the curve of decreasing radium emanation as given by Meyer and Schweidler[3], so that daily values could be accurately reduced for this air radiation. The values were further reduced for some radium radiation, which entered around the microscope, where it is impossible to make the shield as thick as elsewhere. The resulting mean values of the cosmic ultra-radiation plus the zero ionisation of the apparatus are: below 13 m. ore, 0·1346 J; below 28 m., 0·0615 J; below 53 m., 0·0402 J; below 75 m., 0·0374 J; below 86 m., 0·0366 J; and below 104 m., 0·0366 J.

Irrespective of the value of the zero ionisation (*Restgang*), these numbers indicate three components of the cosmic ultra-radiation penetrating 13–86 metres of ore, and the softest component has an 'apparent' mass absorption coefficient of $(\mu/\rho)_{H_2O}$ 0·00020 cm.^{2} gm.$^{-1}$, that is, is identical with the hardest component of E. Regener[2] ($\rho = 5$, $(\mu/\rho)_{H_2O} = 1{\cdot}19\,(\mu/\rho)_{Fe}$). The coefficients of the two harder components are rather sensitive to the magnitude of the zero ionisation, the exact value of which is not yet known but will be observed by the forthcoming measurements below 160 metres of ore at a deeper level of Kirunavaara. The zero ionisation cannot, however, be much less than the value now observed, namely, 0·0322 J., and, taking 0·0300 J. as preliminary value, we obtain as apparent mass absorption coefficients of the two still harder components: $(\mu/\rho)_{H_2O} = 0{\cdot}00011$ and 0·00003 cm.^{2} gm.$^{-1}$ respectively. The first coefficient agrees rather well with that recently found by W. Kolhörster[4] $(\mu/\rho)_{H_2O} = 0{\cdot}00013$ cm.^{2} gm.$^{-1}$, but the second coefficient indicates a hitherto unknown component, much more penetrating than the others, and the existence of this hardest component seems well established by the present measurements. The exact mass absorption coefficients will be calculated, when the zero ionisation has been determined below 160 metres of iron ore.

AXEL CORLIN.

Observatory,
Lund.
Nov. 22.

[1] *Lund Obs. Circ.* 6, 1933.
[2] *Phys. Z.*, 34, 306; 1933.
[3] "Radioaktivität", p. 419; 1927.
[4] *Berlin Ber.*, 23; 1933.

Cosmic Rays and the New Field Theory

REGENER[1] has found that cosmic rays can be observed at 230 m. below the level of Lake Constance. If these rays, as is generally assumed, consist of electrons (not of protons) the great penetrating power raises a serious difficulty in the adopted theory of electronic motion, that is, Dirac's equation. Using this equation, Heitler and Sauter[2] have shown that a beam of very fast electrons (with an energy $E > 200\ mc^2$) should penetrate not more than 1 m. of water when all kinds of absorption processes are taken into account.

The new field theory proposed recently[2] seems to be able to give the explanation of the high penetrating power of very fast particles, either photons or electrons. In this theory there are two types of field vectors, B, E, and H, D, which are identical for very weak fields only. They are different for strong fields, especially in the 'interior' of the electron. The true charge is always concentrated in points, that is, $\operatorname{div} D = 0$, $\int D_n d\sigma = 4\pi e$. But, as has been shown by my colleague, Dr. L. Infeld, a 'free' charge can be introduced with a finite space density, given by $\operatorname{div} E = 4\pi\rho$. This can be considered as the source of the electronic field and as the charge upon which the external field acts, as in Maxwell's theory. For an electron ρ is given by

$$\rho = \frac{e}{2\pi r_0^2} \frac{1}{\frac{r}{r_0}\left(1+\frac{r^4}{r_0^4}\right)^{3/2}}$$

and the space integral of ρ is equal to e.

Under the action of an electromagnetic wave with an amplitude proportional to $e^{2\pi i z/\lambda}$, the behaviour of the electron will be expressed approximately by Dirac's equation provided we replace the charge e by an 'effective' charge $\bar{e}$, given by

$$\bar{e} = \int \rho e^{2\pi i z/\lambda} dV = e f\left(\frac{2\pi r_0}{\lambda}\right), \quad f(x) = \frac{2}{x}\int_0^\infty \frac{\sin xy}{(1+y^4)^{3/2}} dy$$

It is immaterial whether the field be due to a light wave or to the passage of fast electrons; for if $E \gg mc^2$, one has in both cases, with a very good approximation, $\lambda = hc/E$ and

$$x = \frac{2\pi r_0}{\lambda} = 1.236 \frac{2\pi e^2}{hc} \frac{E}{mc^2} = \frac{1.236}{137.1} \frac{E}{mc^2} = \frac{1}{111} \cdot \frac{E}{mc^2}$$

Now the function $f(x)$ is equal to 1, for $x = 0$ (long waves, small energies), but decreases with increasing x. For $x = 2.4$, or $E = 266mc^2$, it is $\frac{1}{2}$, and for $x = 5$ or $E = 555mc^2$, only $\frac{1}{10}$. The cross-section of action, which is proportional to $(\bar{e}/e)^2$, will therefore diminish rapidly with increasing energy of the rays.

Provided the assumption of protons could be excluded, the high penetrating power observed for the cosmic rays may be considered as a confirmation of the new field theory.

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[1] E. Regener, *Phys. Z.*, 34, 306; 1933.
[2] W. Heitler and F. Sauter, NATURE, 132, 892, Dec. 9, 1933.
[3] NATURE, 132, 282, Aug. 19, 1933.

The Pre-Crag Men of East Anglia

IT is common knowledge that the Suffolk Bone Bed beneath the Red Crag is made up largely of the remains of a land surface which existed, for a prolonged period, prior to the submergence of East Anglia beneath the sea of Crag times. Sir Ray Lankester pointed out many years ago[1] that the bones and teeth of land mammals found in the Suffolk Bone Bed are of different ages—some being of a Miocene antiquity, while others are to be referred to certain phases of the Pliocene epoch. He was able also to show that the tooth of a mastodon, by reason of its being partly embedded in a deposit of Diestian sandstone, must be older than this Lower Pliocene accumulation, which is represented in the Suffolk Bone Bed by the well-known fossiliferous box-stones. Thus, by these investigations, it was made clear that, so far as the remains of terrestrial mammals are concerned, the contents of the Suffolk Bone Bed are markedly derivative and referable to widely separated periods anterior to the deposition of the Red Crag.

When, some twenty-five years ago, the announcement was made[2] that flint implements had been found in the Suffolk Bone Bed, a considerable body of opposition to this claim was encountered, and, for a long time, it was needful to concentrate upon the primary task of establishing the fact that the pre-Crag flints had been humanly flaked. But it has now become advisable to proceed to the next stage, and to classify these very ancient relics of man with the view of attempting to ascertain their probable geological antiquity. This process of classification has been made possible by the large number of pre-Crag implements now available for study, and, especially, by the excellent specimens recovered recently during excavations carried out on behalf of the Royal Society, the Wellcome Historical Medical Museum and the Trustees of the Percy Sladen Memorial Fund. The critical examination which has been undertaken of the pre-Crag flints is leading to certain unexpected and far-reaching conclusions, which I propose to set forth briefly here.

It can now be claimed without fear of serious contradiction that, at least, four distinct and different groups of flint implements are contained in the Suffolk Bone Bed. This is established by the fact of the discovery of numerous examples of flints exhibiting flaking of more than one period and in which the newer flake-scars definitely cut into and are patinated a markedly different colour from the older. Moreover, it is apparent that the four types of patination represented can be precisely matched by that to be observed upon a series of implements which are each different in their forms and condition. Thus, for example, the oldest artefacts are thick and coarsely flaked, exhibit a peculiarly archaic, washed-out yellow colour and have evidently been subjected to very considerable striation and abrasion. The latest implements, on the other hand, are usually white or light blue in colour, are little if at all abraded, and are not thick and coarsely flaked. Between these groups are two others which in patination, condition and general appearance are equally distinct from each other.

There is, in fact, as much divergence in these matters, between Group 1 and Group 4 of the pre-Crag implements, as there is, for example, between the Early Chellean and Late Acheulean hand-axes. It is possible also that the gap in time between Group 1 and Group 4 of the pre-Crag industries is greater than that separating the palæolithic implements mentioned. This supposition is based upon the 'morphology' of the former specimens, the thickness and consequent antiquity of the various patinated surfaces, and the fact that there has now been found beneath the Red Crag a well-made rostro-carinate implement which has attached to various parts of its surface areas of material which, so far as a very careful visual examination goes, is indistinguishable from Diestian sandstone.

The manner of distribution of this deposit upon the implement makes it highly probable that the specimen was at one time embedded, like the mastodon tooth described by Lankester, in a Diestian nodule, and must therefore have been made at some period prior to the laying down of this Lower Pliocene stratum. Moreover, the patination of the flake-scars of the rostro-carinate in question is precisely similar to that to be observed upon others which are clearly later in date than the flaking of Group 1 of the pre-Crag implements It would seem to be necessary therefore to relegate the latter to an epoch still further anterior to the Diestian period than is the rostro-carinate to which reference is made

If these conclusions are sound, they give us much additional information upon the question of the antiquity of man. The earliest flint implements in this bed, which comprise primitive though well-made specimens, including rostro-carinates, referable apparently to some at present unspecified period preceding the Diestian, seem definitely to surpass, in their forms and flaking, the type of artefact which, it may be supposed, would have been produced by the most lowly representatives of the human race. The implements of Harrisonian eolithic form associated with Group 1 of the Suffolk Bone Bed specimens were at one time thought to be actually comparable with the well-known Kentian eoliths. But it now appears that the pre-Crag examples are mostly made from intentionally struck flakes and thus represent a more advanced stage of human achievement than do the true Harrisonian implements.

Thus it seems reasonable to conclude that prior to the laying down of the Suffolk Bone Bed, which must pre date by a considerable period the earliest palæolithic civilisations, various races of flint flaking people inhabited the ancient East Anglian land surface. It is clear, from an examination of the pre-Crag implements, that they must be much older than the marine sands under which they now lie, and it is possible that the most ancient groups of artefacts date back to epochs earlier than that known as Diestian. After a very careful consideration of the whole matter, I believe that this is indeed the case, but in order to give all those interested an opportunity for coming to their own conclusions, the large collections of pre-Crag implements in the Ipswich Museum have now been re-arranged upon the lines indicated in this note and can be freely examined by responsible visitors. A representative selection from the four groups of specimens has been arranged as a loan exhibition in the British Museum, and I hope to publish a fully illustrated paper dealing with these implements.

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[1] *Phil. Trans*, B, 1912.

[2] *Proc Prehist Soc East Anglia*, vol 1, pt. 1, pp. 17–43.

Science and Politics

ALL scientific workers will thank Prof. A. V Hill for raising the problem of their status in a world in acute political tension (NATURE, Dec. 23). Most will agree with his main thesis, and few, if any, will hold it to be the duty of scientific societies, such as the Royal Society, to meddle with divinity, metaphysics, morals or politics But this rule applies to the society as a corporate body, and not to its individual members. Those men of science who interest themselves in politics will be unable to agree with Prof. Hill's contention: "If scientific people are to be accorded the privileges of immunity and tolerance by civilised societies, however, they must observe the rules". I am glad to think that individual fellows of the Royal Society, at any rate, have consistently disregarded these rules. Among its earliest fellows, Pepys and Brouncker, to mention no others, meddled in politics; in the eighteenth century, Franklin and Priestley meddled even more conspicuously

Everyone recognises the difficulty of keeping emotion out of one's scientific decisions when they have a political bearing But does Prof Hill condemn scientific men who investigate human heredity because their results discredit the theory of the equality of man, or those who investigate human diet because they demonstrate that a considerable section of the British working classes is underfed? Science could "remain aloof and detached", to use his words, so long as it only concerned itself with man as something to dissect That day is past

Prof Hill condemns the irrational character of certain modern political movements May it not be that the remedy for this lies simply in the application of scientific thought to political and moral problems? It is obvious that such an attempt will endanger the immunity which scientific workers enjoy so long as their opinions are regarded as politically unimportant. But science is in any case in danger of perishing during a general collapse of our political and economic system If we refuse to apply scientific method to human affairs because they are inevitably tinged with emotion, we may help to precipitate this collapse. Such application will be very largely critical, in so far as many political doctrines are based on hypotheses which cannot stand scientific criticism, but it must be to some extent constructive, as when it is pointed out that, owing to defects of Nature and nurture, some men and women cannot play an adequate part in society, and remedies for this state of affairs are suggested.

I do not see why a man of science who "meddles" with such matters should thereby forfeit a right to tolerance, and question whether Prof Hill has done a service to science by penning a sentence which might be interpreted as meaning that his profession should only be tolerated in so far as it is muzzled His subsequent eulogy of independence of thought and speech make it clear that his meaning was quite otherwise. But many of his colleagues will continue to feel that, while scientific societies should restrict their activities to the purest science, their members have not merely the right, but even sometimes the duty, to interest themselves in more controversial matters.

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OF course I would not condemn scientific men who investigate human heredity, whatever their results may discredit, but I should advise them to avoid an emotional bias towards any particular political or social theory which may be affected by their investigations: otherwise experience teaches that their results are suspect Of course I should not condemn scientific men for studying human diet, but the motive should be the discovery of scientific fact, not the demonstration that the British working class is underfed

Prof. Haldane fails to distinguish between "people scientifically trained" who, I urge, "should take some part in affairs" and the scientific investigators themselves. It is perilous, as I said, to disregard the scientific basis of modern civilisation, and all educated men should have some direct appreciation of the methods and ideas of science. This is exactly what Prof. Haldane himself urges in his third paragraph. It is the application of scientific methods to politics and social affairs, and the increase of scientific education and outlook, not the interference of specialist scientific investigators with matters outside their own special competence, which may avert the dangers of which both Prof. Haldane and I are aware. A reputation gained by scientific achievement, and the immunity accorded to scientific pursuits, should not be lightly used to extort consideration in other respects. One may not approve of political intolerance, but one may recognise as a fact that eminent scientific men do well, in the interests of science, to avoid meddling with morals or politics."

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Methods of Ionospheric Investigation

Prof. E. V. Appleton[1] has described a method of measuring the maximum ionisation existing in the lower region of the ionosphere. It is clear from recent work[2,3,4] that, in order to investigate ionospheric fine-structure in sufficient detail, our technique must be improved along at least two lines:—

(1) The time taken in making a measurement of ionisation density should be as short as possible.

(2) Measurement of the equivalent path of the atmospheric rays should be made over a frequency range which is continuous.

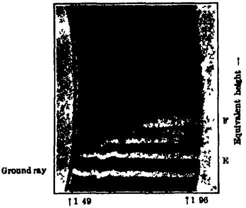

Fig. 1. Frequency in megacycles/sec.

The complexity and sudden changes in ionospheric conditions observed in the polar regions would have made an apparatus embodying such improved technique a powerful instrument in our investigations. The transmitter and receiver were about ten miles apart, so that any form of mechanical linkage or remote control was not practicable. As a result of attempts to meet the requirements, the method finally adopted consisted in increasing continuously the frequency to which the transmitter was tuned and causing the tuning of the receiver to vary in synchronism. The scheme, although not ideal, enabled (2) to be satisfied over a limited frequency range and an approach towards (1) above. The time taken to make one picture (such as that reproduced as Fig. 1) involving a determination of the ionic density was two minutes. The calibration frequency marks which appear on the records were made by attaching a contact arm to the condenser spindle of the high-frequency oscillator of the superheterodyne receiver and arranging that each time this condenser dial responded to the particular frequencies marked on the records, the incoming signals were cut off and a local calibration from a 2·5 kc./sec. time-base was switched on. This condenser spindle was turned uniformly so that it is possible to interpolate between calibration marks on the record.

Records which will show the importance of this type of observation will be published amongst the results of the British Polar Year Expedition to Tromsø. One specimen is reproduced here to illustrate the importance of (2) above. It is a record taken at midnight during the period of the 'midnight sun'. The calibration marks on the left of the picture are caused by a 2·5 kc./sec. oscillator so that the distance between two successive marks corresponds to 0·4 milliseconds or an effective height of 60 km. The picture shows the ground ray and echoes from the *E* region, intermediate region and *F* regions of the ionosphere. There is also a considerable amount of scattering visible. The frequency range shown is only 0·5 mc./sec., but it will be seen that the echo pattern changes greatly over this comparatively small amount. At 1·49 mc./sec. the *E* echo is prominent with a small amount of reflection from the intermediate region. This latter increases with frequency up to 1·93 mc./sec. At 1·7 mc./sec., marked reflection begins from the *F* region and continues to the highest frequency shown. The picture gives some idea of the complexity of the ionosphere in the polar regions.

This work was carried out in May 1933 at Nordlysobservatoriet, Tromsø, as part of the Polar Year programme of the Radio Research Board, and I am indebted to Hr. Harang, director of the Observatory, for the loan of apparatus and for experimental facilities which made these results possible.

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[1] Appleton, Nature, 127, 197, Feb. 7, 1931.

[2] Appleton, *Proc. Phys. Soc.*, 45, 678; 1933.

[3] Appleton and Naismith, *Proc. Phys. Soc.*, 45, 389; 1933.

[4] Schafer and Goodall, Nature, 131, 804, June 3, 1933.

Liquids of High Refractive Index

In measuring the refractive index of precious stones, we have succeeded in extending the range of the total reflectometer type of instrument by the preparation and use of liquids of higher refractivity than the sulphur in methylene iodide solution ($n_D < 1·79$) which is usually employed to make optical contact between the stone and the glass hemisphere of the instrument. The various immersion media of high refractive index proposed by Merwin[1] and Wright[2] were found to be unsuitable. Of a number of compounds prepared the following are worthy of note.

1. Tetra-iodo-ethylene, C_2I_4. This compound dissolves readily in methylene iodide (22 per cent at 15° C.) and with sulphur in this liquid forms a stable clear solution, n_D 1·81, well adapted for routine use with the refractometer[3].

2. Phenyldi-iodoarsine, $C_6H_5As.I_2$. Prepared by the method of Steinkopf and Smie[4] it is a clear orange liquid, d^{15° 2·56, with a high refractive index and dispersion, as shown by the following mean values:

$\lambda(A)$	6708	6438	6141	5893	5535	5350	5106
n^{15°	1·822	1·828	1·835	1·843	1·856	1·865	1·879

Phenyldi-iodoarsine has a blistering action when in contact with the skin, but, handled carefully, provides an excellent liquid for use with the refractometer, and should prove valuable as an immersion medium.

3. Selenium monobromide, Se_2Br_2, has a higher refractive index than that of any pure liquid hitherto recorded. Prepared by direct combination, the value for n_{Li} is 1.96 ± 0.01 rising to 2.02 on exposure to the atmosphere, owing to decomposition of the bromide, with separation and reabsorption of selenium. It is opaque, except in thin films, to all but deep red light, but when mixed with methylene iodide can be used with the refractometer. To obtain a high reading we find it convenient to mix the selenium-saturated bromide with the special methylene iodide solution mentioned above, in small quantities as required. Such mixtures have $n_D > 1.90$ and thus enable readings to be made up to the limit imposed by the refractive index of the glass hemisphere of the instrument (no instrument reading above 1.90).

To make still higher readings possible we hope that fine quality transparent zinc blende (n_D 2.37) may be worked and used in place of the glass, the instrument being suitably modified. Further work on this subject is in progress.

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[1] Merwin, *J. Washington Acad. Sci.*, 3, 35, 1913.
[2] Wright, Carnegie Publication No. 158, Washington, 1911.
[3] *Gemmologist*, 3, 201, 1933.
[4] Steinkopf and Smie, *Ber.*, 59 (B), 1461, 1926.

Crystal Structure of 1-3-5 Triphenylbenzene

A PAPER has recently appeared[1] in which a structure is proposed for 1-3-5 triphenylbenzene, based on X-ray measurements. The unit cell has dimensions $a = 11.2$, $b = 19.8$, $c = 7.6$ A., and contains 4 molecules. No reflections were observed from planes $(h0l)$ where l is odd, and $(hk0)$ where $h + k$ is odd. On the assumption that the crystals are orthorhombic bipyramidal, this would mean that the space-group is Q_h^{16} (P*mcn*) and that the molecule has a plane of symmetry. The authors place this plane of symmetry parallel to (010), but it is clear from the 'absent reflections' that (010) and (001) are both glide-planes of symmetry and that the molecular plane of symmetry, if it exists, must be parallel to (100). This result is incompatible with the authors' structure and also, as it happens, with the most probable dimensions of the molecule and the actual intensity data.

The explanation of this apparent anomaly is that the crystal class is not orthorhombic bipyramidal, but orthorhombic pyramidal. The crystals show a small, but quite definite, piezo-electric effect, indicating that the crystallographic 'a' axis is, in reality, a polar axis. The molecules are *asymmetric*, though pseudo-trigonal, and the plane of the benzene rings is not coincident with the crystallographic (001) plane, as in the proposed structure, but makes a small angle with that plane. A complete account of the correct structure, based on accurate X-ray intensity measurements, together with optical and magnetic data, will be published shortly.

Meanwhile the importance of making piezo-electric measurements whenever possible cannot be too strongly emphasised, as lack of knowledge may otherwise lead not only to the assumption of too much molecular symmetry, but also to a completely incorrect structure. It is, I think, a fact that in every case for which a plane of symmetry in the benzene ring has been reported, the presence of a piezo-electric effect (not tested for) would eliminate that plane.

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[1] E. Hertel and G. H. Römer, *Z. phys. Chem.*, B, 23, 226, 1933.

A New Wound Parasite of Potato Tubers

IN a recent communication, Mr. S. F. Ashby of the Imperial Bureau of Mycology, Kew, informs me that he has not been able to find a record of *Fusarium viride* (Lechm.), Wr. on potato or of any tests of its parasitism on that host. Recently Wollenweber[1] has renamed it *F. solani* var. *medium*, Wr., but its pathogenicity does not appear to have been tested.

Single spore cultures of *F. viride*, kindly identified by Dr. Wollenweber, were inoculated into potato tubers by a slightly modified method of Granger and Horne[2]. After 24 days at room temperature (20°–25° C.) all the inoculated potatoes showed a well-advanced dry rot with a wrinkled sunken patch and whitish pustules on the surface near the plug. The fungus was re-isolated in a pure form both from the diseased parts as well as from the pustules. Its saltant was as virulent as the parent. *F. moniliforme*, *F. camptoceras*, *F. diversisporum*, *F. semitectum* and *F. semitectum* var. *majus* failed to infect the tubers. The controls all remained healthy.

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Nov. 30.

[1] "Fusarium Monographie", 1931.
[2] *Ann. Bot.*, 38, 212, 1924.

Scurvy in the 17th and 18th Centuries

THERE is an English seventeenth century reference to the treatment of scurvy, which, perhaps, is not so well known as it might be. John Woodall, author of "The Surgeon's Mate, or Military and Domestique Surgery", 1639, wrote on p. 171, "juyce of lemmons was ever reputed a cold medicine, prescribed and given daily by physicians in burning and pestilentiall fevers, and that with good reason and good successe even to this day, and yet to that notable and cold and terrible disease of the Scurvy, how excellent hath it been approved . . ."

In the next century, Capt. Cook did not find citrous fruits to be of striking value, for a very good reason arising from the nature of his supplies. There is appended to his paper in *Phil. Trans.*, vol. 66, 1776, a letter in which he writes: "I have no great opinion of them alone", 'them' being oranges and lemons, preserved as a 'rob' or syrup of *boiled* juice.

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Dec. 21.

Research Items

China and the Maya. A communication from Dr. Kiang Kang-Hu on the resemblances between the Maya civilisation of Central America and that of the Chinese, accompanied by an introductory note, dealing broadly with the question of cultural diffusion across the Pacific, by Dr. W. D Lighthall, has appeared (*Trans. Roy. Soc Canada*, Ser 3, 27, Section 2) Dr. Kiang from his familiarity with the cultures of his own and kindred peoples is able to bring forward a number of instances, in which he sees resemblances between the two civilisations, for the further scrutiny of specialists Among these are the physical characters and the mental outlook of the two peoples, the Maya more nearly resembling the Chinese physically than any other of the aboriginal tribes of Central and North America He also points to similarities in language, in the complicated and elaborate calendrical system, both peoples using the 'large' and 'small' month count Their religion and deities, sacrifice and worship are also alike, especially in regard to the use of idols of wood and clay to which human blood was applied. China, however, does not appear to have practised human sacrifice, although there are traditions of it in ancient days and remote parts The astronomical and astrological systems are strikingly similar; and the creation legends of the two peoples have many common features, as also have the story of the deluge and of the creation of the first men out of mud Art, dress and ornament are reviewed with the same result Setting aside the elements which are common to many primitive peoples, many resemblances remain which cannot be dismissed lightly If the Mayas were of Chinese origin, they must have crossed to America more than six thousand years ago, otherwise their culture would be more specifically Chinese Alternatively, they may have been derived from other adjacent races, different from, but culturally related to, the Chinese.

Phylogeny of Hemiptera–Heteroptera. In describing a new family, Leotichidæ (*Ann. and Mag Nat Hist*, Ser 10, 12), W E China discusses the general classification of Hemiptera–Heteroptera and proposes a hypothetical phylogenetic arrangement of the 51 families at present recognised within this suborder This arrangement is compared with the latest attempt by Pruthi (*Trans Entom Soc*, *London*, 1925) to revise the family classification solely on the basis of the morphology of male genitalia It is stressed that there are no grounds for assuming that genitalia are less affected by environment and habits than are other characters. Indeed, the fact that whole groups of species exist which differ only in genital structures would seem to indicate that often these structures are the first to be affected It is only the general plan of genital structures which is of value in supplying important clues to the phylogeny of the group. The two main types of genitalia, those of the pentatomoid and reduvioid groups of families respectively, follow the biological difference in feeding habits, members of the first group being mainly phytophagous, and those of the second mainly predaceous. Nevertheless, the primitive Heteroptera were undoubtedly phytophagous, not predaceous, and were homopteroid in character. The family Corixidæ contains the only aquatic phytophagous Heteroptera, and it is considered to represent the aquatic form derived from those ancestors, whereas the true aquatic bugs (as opposed to the littoral and surface forms) arose from predaceous terrestrial forms of the littoral type, at a much later date A biological sequence showing a gradual change from littoral life to a truly aquatic existence is traced from family to family, and a 'family tree' including all known families serves to illustrate the interesting discussion.

South American Lizards. A preliminary check list of the lizards of South America has been compiled by Charles E and May Danheim Burt (*Trans. Acad. Sci. St Louis*, 28, Nos 1 and 2; 1933). The authors consider that probably, in their catalogue of 86 pages, they have listed too many rather than too few species, and that great systematic modifications of the present groupings must ultimately be made. But the list should stimulate field work and research on South American lizards, the more so since the distribution of even common species is not precisely known, and since little has been published concerning the habits and habitats of any

Reproductive Apparatus of *Thalassema*. P R Awati and D S Deshpande (*J Univ. Bombay*, 1, Pt. 5, 1933) describe the reproductive apparatus of *Thalassema bombayensis* The single gonad is around the posterior part of the ventral vessel, and from it fall into the cœlom clusters of cells which in males develop into sperm morulæ while in females one cell in the centre of each mass enlarges and becomes an ovum growing at the expense of the sister ova. There are usually four pairs, occasionally five pairs, of gonoducts in the anterior region of the body. Each organ consists of a vesicle into which opens the common duct of two spiral 'flagella'; from the vesicle issues a short duct which opens to the exterior The vesicle is small in immature examples but in mature specimens is distended with the sexual cells. Each 'flagellum' is ciliated along its margins and along its length has a ciliated groove. The two 'flagella' meet and fuse, the two grooves forming a common duct which opens into the vesicle; near this the short duct leads from the vesicle to the exterior. The sexual cells are brought from the cœlom into the vesicle by the ciliated grooves of the 'flagella', accumulate therein and finally pass to the exterior by the short efferent duct. The authors regard these 'segmental organs' as cœlomoducts

Fungi of Butter. Many of the taints and faults of butter are due to the activities of fungi. This fact has led workers in several countries to study the fungi which occur naturally or appear during the manufacture of this product. A very complete list is published in vol. 9 of the *Canadian Journal of Research* ("The Fungi found in Butter", by G. R. Bisby, M C. Jamieson and M. Timonin, pp. 97–107, Aug 1933) Samples of butter from all the creameries in Manitoba were tested for the presence of fungi. One creamery produced butter with no moulds, and the product was of excellent flavour. A long list is given of all the fungi isolated from other samples, not only by the authors, but also by other workers on the same subject, and should prove valuable to dairy workers for reference.

Mesozoic Pteridosperms from South Africa. In a recent publication (*Phil. Trans Roy. Soc. London*, B, 222) Dr. Hamshaw Thomas gives an account of some remarkable fossil plants from rocks of Triassic Age in Natal which notably extends our knowledge of Pteridosperms as constituents of post-Palæozoic floras. He describes an interesting set of seed-bearing and pollen-bearing fructifications which, by evidence of cuticular structure, other morphological considerations, and close association, he is able to relate to one another and to such well-known form-genera of fronds as *Thinnfeldia*, *Dicroidium*, *Pachypteris*, etc., fronds which have for some time been suspected, without adequate evidence, of being pteridospermous. These he groups into two families (1) the Corystospermaceæ, characterised by having seed-bearing branches with terminal recurved cupules each of which bears a seed with a curved bifid micropyle. The pollen-bearing branches bear their microsporangia in groups on small laminæ, and the microspores, which have also been found adhering to the nucellus in the seeds, have two lateral, symmetrical wings and closely resemble those of *Antholithus* in the Caytoniales. The foliage probably was of the types known as *Dicroidium* and *Pachypteris*. (2) The Peltaspermaceæ, a closely allied family, have seed-bearing branches with the seeds attached to small peltate terminal expansions of the axis. The foliage was of the *Lepidopteris* type but the pollen-bearing structures have not as yet been identified. These discoveries have an *important bearing on the question of the* possible origin of the Angiosperms from a Pteridosperm stock and on the morphological nature of seed-bearing structures in general.

Artificial Vibrations of the Ground. Some interesting experiments on this subject, made by S. K. Banerji and M. D. Manohar, are recounted in the *Indian Journal of Physics*, 8, 95, Sept. 1933. An iron ball of about 28 lb. weight was dropped on to the ground from a height of about one yard, and the resulting ground vibrations were measured by two horizontal component (north-south and east-west) Milne-Shaw type seismographs (period 12 sec., damping ratio 20 · 1) and a vertical component seismograph (period 3 sec.). Records were taken when the point of impact was in different directions from the small seismograph house, and at numerous distances up to about 50 yards. The records show a sudden impulse followed by oscillations compounded of forced vibrations of the ground (period 0·05 sec.) and the free period of the seismograph house (0·015 sec.). Using a theory given by Lamb, the ground vibrations, and their law of variation of amplitude with distance (proportional to 1/√distance) can be reasonably well accounted for. The free period for the building also agrees with a theoretical estimate.

Landing of Aircraft by Radio. The October *Bulletin of the Bureau of Standards* contains a description of the complete form of the equipment for enabling aircraft to land in fog or other conditions of low visibility. The methods have been developed since 1928, and have now been incorporated into a practical form and tested by repeated use in actual fog and in an aeroplane with hooded pilot's cockpit. The course of the aircraft is directed to the airport by a beacon station using a 200–400 kc. frequency and a visual indicator on the machine. The intensity of the beacon signals provides an approximate indication of the distance from the airport on a milliammeter graduated in miles. When several miles from the airport, the machine picks up a landing beam from a special short-wave transmitter (10,000 kc. frequency) which is arranged so that a surface of constant signal intensity is a sloping path down which the aeroplane may glide. The signal intensity meter on the aeroplane is combined with the beacon indicator, so that the pilot needs only to keep the two pointers intersecting over the centre of the dial by movements which easily become intuitive. As the machine approaches the airport it picks up a marker signal beam modulated with a distinctive tone and directed vertically at a position a few thousand feet from the landing field. At the edge of the field itself a second distinctive marker tone is heard. The aeroplane is then only a few feet from the ground and a landing may be effected without difficulty (see also NATURE, 132, 925, Dec. 16, 1933).

Helium in Beryl. Lord Rayleigh (*Proc. Roy. Soc.*, Nov.) has made determinations of the helium content of a number of specimens of beryl of varying geological age. The beryls were finely powdered and decomposed with molten caustic potash at about 300°; the gas was purified and measured over mercury in a McLeod gauge. The beryls obtainable were predominantly from Archæan formations, but a number of specimens were classified as Palæozoic, Mesozoic or Tertiary. Within each group the helium content was very variable, but the helium content showed a definite tendency to *increase* in *going from* younger to older specimens. The largest helium contents were limited to specimens of great geological age. The conclusion appears to be that the helium has accumulated in beryl during geological time, and that it was not trapped when the mineral was formed or produced by the disintegration of short-lived radio elements during the early life of the beryl.

Holley-Mott Continuous Counter-Current Washery and Petroleum Products. In a paper read on November 14 before the Institution of Petroleum Technologists, Mr. E. Thornton maintained that sponsors of the Holley-Mott continuous counter-current washery for the treatment of cracked spirit were justifiably proud of the good results achieved with this plant, the usefulness of which is determined solely by the application of generally accepted principles in the most straightforward manner. All good treating plants must be so designed as to be capable of mixing reagent and treated material in suitable proportions, maintaining the admixture for a given length of time and separating reagent and treated material at the expiration of that time. Intimacy of contact between reagent and treated material is achieved in the Holley-Mott process by means of a vessel containing a suspended stirrer revolving at a moderate speed and with no footstep bearings. Not only is this method of mixing simple and efficient, but it is also definitely economical. The time of contact between reagent and treated material is controlled by the size of the vessel in relation to throughput, as is the case with most continuous plants. Since the degree of mixing is kept definitely under control, the problem of separation is not formidable and is solved simply and cheaply by means of gravity-settling in reasonably-sized vessels. In addition to fulfilling the above main requirements, the Holley-Mott plant satisfies a number of other conditions essential to the effective treatment of spirit.

Annual Meeting of the Science Masters' Association

THE thirty-fourth annual meeting of the Science Masters' Association was held at the Imperial College of Science, London, on January 2–5. More than 600 members attended

This year's president, Mr H T Tizard, Rector of the Imperial College, inaugurated the proceedings, after the annual dinner, with an address on "Science and the Industrial Depression" He referred to the gloomy picture of the immediate future envisaged by Dr Norwood in his presidential address two years ago, and how it had been justified by succeeding events There was a widespread belief that science contributed to industrial depression in creating unemployment by substituting the machine for the man, in discouraging skill by replacing skilled work by unskilled work, and in promoting discord by increasing the powers for evil. The last, however, was a moral question, the decision to use the powers of science for good or evil being dependent upon education

Mr Tizard denied that it was true that the progress of science tended to discourage skill, what it had really done was to replace one skill by others In the matter of increase of unemployment, figures were given for both England and the United States to show that mechanisation actually increased the number of wage earners between 1914 and 1927 The responsibility for industrial depression lay with the economist and politician rather than with scientific workers

It was possible, however, that because of the inertia of industry in times of prosperity, continuous advantage was not taken of new inventions and discoveries of science Consequently, a set-back, due to whatever slight cause, would put into operation widespread economies, and sudden application of scientific labour saving devices that would give rise to the unemployment of many workers who, however, were really superfluous to industry, even in times of prosperity The coal industry was given as an example

To overcome this industrial apathy towards the application of science, it was necessary for science to be added to the mental equipment of administrators, possibly by a combination of science and economics at the universities Moreover, it was the duty of all science masters not only to imbue the gifted few of their pupils with the spirit of intellectual adventure, but also to impart to many the power of observation and the skill of hand that bring interest and happiness to life, and to send all out into the world with a sense of fact and a sense of law

Prof E N da C Andrade in his lecture on new experimental work in sound, dealt with the phenomena associated with Chladni's plate, Kundt's tube and the sensitive flame, and showed by ingeniously simple experiments new facts that could only be explained by new theories. In particular, the vortex theory, which explained the phenomena of Kundt's tube, made possible very accurate measurement of the velocity of sound. It was found that the velocity of sound did in some measure depend upon the frequency and that previously noticed but ignored irregularities in the velocity of sound in the work of other investigators were of significance

The nature of heavy hydrogen and heavy water was the main feature of interest in Prof H V. A Briscoe's lecture on recent advances in chemistry. The nomenclature of the new hydrogen, and its isolation by electrolysis, fractional distillation, or fractional diffusion through palladium were described. The properties of heavy water, f p 3 8° C, b p 101 4° C, density 1 1056, temperature of maximum density 11 6°, its 50 per cent greater viscosity and its biological effects excited great interest, as did the discussion of the theoretical implications in the matter of atomic structure

Dr Allan Ferguson provided a most interesting lecture on London's contributions to science, ranging backwards from Lord Rayleigh, Clerk Maxwell, Faraday, Wollaston, Young, Cavendish and Halley, to Wren and even Chaucer The biographical details of these celebrities were supplemented by interesting historical exhibits

The evening lecture on January 3 was devoted to fungi, by Mr J Ramsbottom, who, starting from yeast and its influence on life's necessities, beer, bread and cheese, proceeded, with the aid of beautifully coloured slides, to demonstrate the difference between edible and poisonous fungi

Very interesting experiments capable of school demonstration, and therefore doubly valuable to the science masters, were shown on January 4 by Mr. H. Haile, in his lecture on the polarisation of light and its application to applied science This was followed by a lecture by Prof A Brammall on geochemistry applied to the genetic study of 'hybrid' rock types—a compact summary of useful information In the evening, the Astronomer Royal, Dr H Spencer Jones, summarised the modern views on the structure of the universe, illustrating his discourse by striking astronomical photographs, particularly of the Milky Way There was a further lecture on January 5 by Prof R A Fisher on adaptation and mutations

It has always been a feature of the annual meeting of the Science Masters' Association for members to exhibit and demonstrate with home-made apparatus new technique, methods and notions developed in the school laboratories Many of these are now found in the "Science Masters' Book", published by the Association This year, the members' exhibition was larger than ever, and full of stimulating ideas A gramophone record used to reflect light, giving rise to interference fringes, 'Cellophane' as a semi-permeable membrane, milk bottles as gas jars, soap bubbles blown in an enclosed space so that they may drain undisturbed in order to demonstrate colours of thin films, were among the striking features

There was a much appreciated innovation this year in that Mr F A Meier was invited to give a lecture demonstration on some of his ingeniously simple experiments, which obviously delighted the lecturer as well as the audience With the aid of toy trucks, thermos flasks, home-made springs, football bladders, balloons, bicycle wheels, pickaxes, flour bins, he demonstrated principles of mechanics, hydrostatics, properties of matter, light, heat, electricity and magnetism Moreover, these experiments were quantitative, and Mr. Meier was able to show that it was usually possible to obtain at least a one per cent accuracy

In addition to these lectures, there were two important discussions, one on the School Certificate biology syllabus, and the other on the elementary science suggested by the School Certificate Investigators' Report as a compulsory subject at the School Certificate stage. This latter discussion will form the subject of a further report

Visits were paid by various members to seventeen factories and Government scientific institutions in and around London These included, among others, the Courtauld Institute of Biochemistry, the Paint Research Station, Government Laboratories, the Royal Observatory, the Royal Aircraft Establishment, and the Royal College of Surgeons These, together with the exhibition of scientific textbooks and apparatus, made a very full programme Twenty-three publishers and thirty-nine manufacturers and thirty-five members exhibited

The next annual meeting will be at Oxford under the presidency of Dr N V Sidgwick F W. T.

Annual Meeting of the Mathematical Association

THE annual meeting of the Mathematical Association was held at the Institute of Education, London, W C 1, on January 4–5, under the presidency of Prof G N Watson Discussions on the place of mathematics in the new central schools, on the interesting and novel suggestion that in the teaching of elementary geometry, solid geometry should precede plane geometry, and on the place of differentials in the teaching of the calculus, showed that the Association has not forgotten its primary purpose, the improvement—if necessary, the reform—of the teaching of elementary mathematics

Under the title "Scraps from some Mathematical Note Books", Prof Watson delivered a lucid and stimulating presidential address It was based on the diary in which C F Gauss (1777–1855), one of the greatest mathematicians of all time, recorded many of his discoveries; Gauss started keeping this diary at the age of nineteen, and it is remarkable that the majority of the hundred and fifty entries were made before 1801

The first entry is the discovery of the possibility of a ruler and compass construction of the regular polygon of seventeen sides, a particular case of a more general problem to which Gauss himself gave a complete answer at a slightly later date There are several entries referring to the quadratic reciprocity theorem, another, prefaced by a triumphant "Eureka", is equivalent to the result that every integer of the form $8m + 3$ is expressible as the sum of three odd squares Other entries mentioned by Prof Watson deal with continued fractions, the zeros of a Bessel function, and a function which is connected with the famous zeta function of Riemann In connexion with this last entry, Prof Watson pointed out that in a copy of Schulze's logarithm tables inscribed "Gauss, 1791", Gauss has made a note which can readily be interpreted as a statement that the number of primes less than a large number x is approximately equal to $x/\log_e x$, this is the "prime number theorem", of which the first proofs were given by Hadamard and de la Vallée Poussin in 1896

In addition to describing these striking results, Prof. Watson gave a brief account of the developments to which these results have led, concluding with a description of some remarkable numerical work connected with the prime number theorem which was carried out in 1933 His general aim was not only to honour Gauss but also to stress the importance to mathematicians of the dictum of N H Abel (1802–29) who, when asked how he had been able to accomplish so much in so short a time, replied. "By studying the masters, not the pupils"

Prof. E H Neville, professor of mathematics in the University of Reading, has been elected president of the Association for the forthcoming year

Research at the Cawthron Institute

THE Cawthron Institute at Nelson, New Zealand, was founded and endowed through the munificence of Mr Thomas Cawthron, who was born in 1833, and after his death his trustees decided that a research institute for the investigation of agricultural problems should be established as the best means of carrying out his expressed desire. The Cawthron centenary lecture, "The Achievements of the Cawthron Institute", delivered on October 9 by Prof T H. Easterfield on his retirement from the directorship of the Institute, formed a fitting epilogue to the first Cawthron lecture, "The Aims and Ideals of the Cawthron Institute", given by him in 1917.

Beginning with the early work of the Institute, Prof Easterfield said that one of the first problems to be attacked was the improvement of the fruit industry A soil survey of the Nelson province was initiated, and the distribution and special characteristics of the soils studied with particular reference to fruit growing The information thus gained led to recommendations with regard to soil treatment and cover cropping without which many orchardists would have been obliged to abandon their crops. Biological problems such as bitter-pit, black spot, woolly aphis and codlin moth were investigated concurrently. An insect, *Aphelinus mali*, was imported in 1920 for the control of woolly aphis and induced to breed in New Zealand Its remarkable success is evidenced by the fact that it is no longer necessary to spray trees which formerly had suffered heavily Such parasitic control is being extended with promising results to other insect and plant pests including the blowfly, which attacks lambs, and the piri-piri, a burr-producing plant which seriously reduces the commercial value of wool fleece Much useful work has been done in controlling fungus diseases of fruit and flowers In the work on black spot, the main fungal disease of pip fruit, it has been found that infection can be controlled by spraying at a period, varying with the season, when ascospores are just about to be ejected by the fallen leaves of the previous year

Prof Easterfield gave further instances of researches which have resulted in outstanding increases in the production of fruit and other important crops, notably the control of brown rot in peaches, the improved fertilising of raspberries, the selection of soils for tobacco and lucerne, the steam sterilisation of tomato soils, and the cultivation treatment of barley Discussing the extensive work on the mineral content of pastures, he said that the data so far recorded promise to have a very marked effect on the agricultural practice of the future, and emphasised the importance of supplementary fodder production for stock Studies of stock ailments such as bush-sickness and xanthin (urinary) calculi of sheep have also yielded conclusive evidence indicating the means of controlling them The first, due to nutritional deficiency of iron, has been shown to be due to lack of soluble forms of iron in the soil rather than in the pasture, stock appear to derive much of the iron they need by ingestion of the soil itself It has also been shown that xanthin calculi can be avoided by the encouragement of English grasses and clovers, by suitable top-dressing, and by the supply of supplementary feeds.

Among other examples of the practical value of the work of the Institute, Prof. Easterfield referred to the economic importance of the investigations carried out on the reclamation of the extensive pakihi lands occurring chiefly in the more populated mining districts Field plot studies have shown that it is possible to bring the land, supporting only fern and rush in its natural state, into a condition suitable for dairy farming at a cost as low as £6 per acre

The Japanese Seismic Sea-waves of March 3, 1933

THOUGH we may have to wait some time for the complete reports on the great Japanese earthquake of March 3, 1933, some valuable papers have recently been published*, of which an abstract is here given The earthquake occurred at about 2 32 a m, Jap Stand Time, on March 3 (5 32 p m on March 2, G M T). From the records at stations connected with the Earthquake Research Institute, Prof Ishimoto finds the epicentre to be in lat 38 2° N, long 144 0° E., while the observations at Tokyo, according to Prof. Imamura, place it in lat 38 5° N., long. 143 3° E The latter point is represented by the more southerly of the two crosses in the accompanying map (Fig 1), the other being the epicentre of the great earthquake of June 15, 1896. The dotted lines on the map are isobaths in thousands of metres, and the two points, which are about fifty miles apart, both lie near the isobath of 4000 metres or about $2\frac{1}{2}$ miles, on the northern slope of the Tuscaroora Deep, the depth of which exceeds five miles

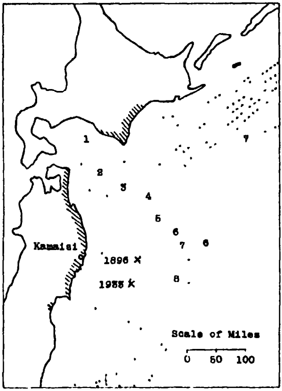

FIG 1 Isobaths of the Japanese earthquake of March 3, 1933

The point given above is that below which the movement of the crust block began It differs slightly, however, from the origin of the great sea-waves. Assuming the velocity of the waves to be $\sqrt{(gh)}$ ft per sec., where h is the depth in feet, Mr. R Takahasi has determined the position of the wave-centre from the times of arrival of the sea-waves at Miyako, Tyôsi and Tukihama, namely, lat. 38 3° N, long 143 6° E

Both points, however, being about a hundred miles from the coast, the shock, though widely felt on land, caused only slight damage along and near the coast After an interval, ranging from 25 to 40 minutes, the great sea-waves swept over the shores shaded on the map, and drowned 3,022 persons, washed away 6,889 houses, besides destroying more than 8,000 boats and other vessels In 1896, the earthquake was less severe than in 1933, but the waves were in most parts higher, and the destruction was far greater, 27,122 lives being lost and 10,617 houses washed away. In Hokkaido, the greatest height of the waves as shown by marks left on trees, posts, slopes, etc, was 15 ft. In the Main Island, it was 15 ft at Kamaisi, the place that suffered most in 1896, but somewhat farther to the south, it rose to 62 ft along the coast at Ryôri Sirahama (and 93 ft inland) and 75 ft. at Hirota Atumari. The waves swept in with such velocity that a motor-boat from Kamaisi, with a speed of 12 miles an hour, could make no headway against them. Across the Pacific, they were recorded by mareographs at Honolulu, San Francisco and Santa Monica.

Mr. K. Musya has made an exhaustive study of the luminous phenomena seen as the waves came in. Among them is reported a strong flash of light that seemed to be emitted from the surface of the sea near the mouth of Kamaisi Bay. Prof. Terada shows that the most probable explanation of the flash is that the turbulence of the water in front of the

* M Ishimoto Preliminary notes on the *tsunami* of March 2, 1933 (G M T), and an outline of the investigations now being made concerning it at the Earthquake Research Institute *Japan J. Astron Geophys*, 11, 1–9, 1933

T Matuzawa, K Kanbara and T Minakami. Horizontal movement of water in the *tsunami* of March 3, 1933, *ibid*, pp. 11–16

A Imamura and Z Kawase The Sanriku *tsunami* of 1933, *ibid*, pp. 17–35

T. Terada Luminous phenomena accompanying destructive sea-waves (*tsunami*). *Proc. Imp Acad*, Tokyo, 9, 367–369, 1933

Notes on the prevention of damage from *tsunami*. Issued by the Imperial Earthquake Council, 1933.

advancing wave excited simultaneous luminosity in a swarm of, say, *Noctiluca miliaris*.

The coasts of Sanriku contain many V-shaped indentations facing the Tuscaroora Deep, and they have suffered so often from the sea-waves from the northern slope of the Deep, especially in 869, 1611 and 1896, that the Imperial Earthquake Investigation Council has issued a volume of notes on the prevention of damage from *tunami*. The main suggestion is the removal of coast villages to elevated ground, but, if this should be impossible, the construction of defence works, such as sea-walls and breakwaters, or groves of trees, and the provision of avenues of escape and *tunami* warnings. C D.

University and Educational Intelligence

LONDON.—A special committee has been appointed to report fully as a matter of University policy on the amount and nature of technological study at present carried on in the University, and as to the desirability of instituting a new Faculty of Applied Science or Technology.

IT is announced that Miss Ethel Strudwick has been appointed a trustee of the London Museum Miss Strudwick is high mistress of St Paul's Girls' School, and her appointment is intended to associate schools with the museum.

A COURSE of nine lectures on cathode ray oscillographs will be given at East London College, Mile End Road, London, E 1, on Mondays at 5 30, commencing on January 22 The first lecture, entitled "Cathode Rays and their Use in Electrical Engineering", will be delivered by Prof J. T MacGregor-Morris; lectures 2–5, entitled "Low Voltage Oscillographs", by Mr. L. H. Bedford; and lectures 6–9, entitled "High Voltage Oscillographs", by Prof. G I Finch. Admission will be free, without ticket

ON the place of biology in education hangs the efficiency of efforts to popularise appreciation of the laws of health In this belief, the British Social Hygiene Council organised a year ago a conference on the subject, and set up in March last, as an outcome of the conference, an Educational Advisory Board In a leaflet recently issued, the objects of the Board, its composition and committees and the services it offers are set forth in detail It aims at promoting the teaching of biological sciences in all kinds of educational institutions, at securing adequate recognition for biology as a general and as a specialist subject by examining bodies, and at giving guidance in the production of textbooks and teaching material Its chairman is Dr. W. W. Vaughan, formerly headmaster of Rugby, and among its members are representatives of the Board of Education and the Scottish Education Department, of most of the universities of Great Britain, of several examination boards, of many associations of members of the teaching profession and of local education authorities. One of the standing committees concerns itself with the teaching of biology in outlying parts of the British Empire, especially colonies and protectorates and mandated territories under British rule. The Board offers a variety of services including recommendation of books, advice regarding syllabuses and information about current research in methods of teaching.

Science News a Century Ago

Death of M. Hachette

On January 16, 1834, the eminent French mathematician and engineer, Jean-Nicolas-Pierre Hachette, died in Paris at the age of sixty-four years. Born in Mézières on May 6, 1769, he was the son of a bookseller and was educated at Charleville and Rheims At the age of nineteen he became a draughtsman in the military engineering school at Mézières, and four years later was made a professor of hydrography at Collioure. His mathematical writings having brought him to the notice of Monge, who then held the post of Minister of Marine in the Revolutionary Government, Hachette in 1793 was made a deputy-professor at Mézières, and the following year at the battle of Fleurus on June 26, 1794, he assisted Guyton de Morveau in the experiment of using a balloon for military observations A few months later, after the fall of Robespierre, he assisted Monge and Guyton de Morveau in founding the École des Travaux Publiques, renamed in 1795 the École Polytechnique, and was given the chair of descriptive geometry. In 1798 with Berthollet, Monge, Fourier, Jomard and other savants he accompanied Napoleon to Egypt. Once again in France, he resumed his lectures at the École Polytechnique, having among his students Arago, Poisson and Fresnel At the restoration in 1816, like Monge he was deprived of his chair and twice the Government refused to allow his election to the Academy of Sciences, which he did not enter until the Revolution of 1830 His writings comprise an admirable series of works on descriptive geometry, many reports on mathematical and physical subjects and memoirs on machines Though his name is connected with no great discovery, his services were of great importance to constructors of machinery, and as a man he was respected for his amiability and uprightness.

Sir John Herschel at the Cape

After his father's death in 1822, Sir John Herschel lived at Slough with his mother, continuing the survey of the northern heavens with the 20 ft. telescope he had made under his father's directions. His 'sweeps' resulted in a catalogue of 2,307 nebulæ of which 525 were new discoveries, presented to the Royal Society in 1833. "Strongly invited," as he himself said, "by the peculiar interest of the subject, and the wonderful nature of the objects which presented themselves," he resolved to attempt the completion of the survey of the southern hemisphere, and on November 13, 1833, embarked with his wife and family in the *Mount Stewart Elphinstone*, and after a prosperous voyage landed at the Cape on January 16, 1834, about ten days after Maclear, the successor of Henderson as H.M. Astronomer "Choosing as the scene of his observations a rural spot under the shelter of Table Mountain, he began regular 'sweeping' on the 5th of March The site of his great reflector is now marked by an obelisk, and the name of Feldhausen has become memorable in the history of science; for the four years' work done there may truly be said to open the chapters of our knowledge as regards the southern skies" (Clerke).

Herschel's work at the Cape led to an extraordinary hoax which had a remarkable sequel. On the staff of the newly-founded New York *Sun* was the reporter Richard Adams Locke Locke contributed to the *Sun* a series of articles stated to be based on Herschel's discoveries with a giant telescope which enabled him "to study even the entymology of the moon in case she contained insects upon her surface". The fake, of course, was later on exposed, but was regarded with amusement. It had helped to establish the *Sun*, which achieved the largest circulation of any daily in the world, 19,360 copies as against the 17,000 of the London *Times*, and led to the birth of cheap newspapers "We are indebted," said Edgar Allen Poe, "to the genius of Mr Locke for one of the most important steps ever taken in the pathway of human progress" (see *British Weekly*, Jan 16, 1918)

Examination of Mummies

A mummy was opened at the College of Surgeons on January 16 by T J Pettigrew, F R S , in the theatre of the College, before a very crowded audience, consisting not only of members of the College, but also scientific men generally who had been invited by advertisements It was stated that the mummy was the property of the College, and had been in its museum since 1820, brought from Thebes by Henderson Mr Pettigrew said that a mummy opened at the Leeds Philosophical Society was covered an inch thick with an aromatic powder In concluding his discourse, Mr Pettigrew expressed his pleasure that this antiquity had proved to be a male subject, as he had predicted, and did not therefore bring into question his reading of the inscriptions

Quantity of Electricity to Decompose a Grain of Water

Faraday's experiments on the decomposition of compound bodies by electrolysis, described in the Seventh Series of the "Experimental Researches in Electricity", led him to speculate as to the "quantity of electricity associated with the particles or atoms of matter", and his wonder was excited by the "enormous electric power of each particle or atom" which his measurements showed "What an enormous quantity of electricity therefore", he says, "is required for the decomposition of a single grain of water" He compares the quantity of "voltaic" electricity required for the purpose, measured electro chemically, with that of "common" electricity from the frictional machine, and finds that "the proportion is so high that I am almost afraid to mention it" This experiment was recorded on January 17, 1834, in the Diary ("Faraday's Diary" Vol 2, p 214) The "battery" was a little voltaic arrangement of zinc and platinum wires dipping into sulphuric acid .

"Now in this form of battery 1 gr of water require solution of 3 6 grains of zinc—and as 6 8 gr dissolved in 7 days, 3 6 would require 3 7 days ; but if a wire 5 inches long required 3·7 days to loose 3 6 grs , one only ⅛ of an inch in length but of the same diameter would require 29 6 days for solution of same weight, if constant action could be sustained Now the comparitive battery required 0 0533 of a minute to equal one charge of Leyden battery, but 29 6 days divided by 0 0533 of a minute gives very nearly 800,000. So that from this calculation the electricity required to decompose a single grain of water is about equal to that of 800,000 charges of the Leyden battery, any one of which would kill a cat or dog."

Societies and Academies

LONDON

Physical Society, Dec. 15 G. I FINCH and A G. QUARRELL : Crystal-structure and orientation in zinc oxide films. A new type of electron-diffraction camera is described incorporating means for greatly increasing the accuracy hitherto obtainable in electron-diffraction analysis Partially and completely oxidised zinc films have been examined by transmission. The normal type of zinc oxide is formed by the oxidation of zinc via a zinc oxide which is basally pseudomorphic with the zinc. The corrosion-resisting properties of zinc appear to be due, in the main, to a protective coating of such pseudomorphic zinc oxide A. O RANKINE . Note on the behaviour of the Eötvös gravity balance in fluctuating gravitational fields Attention is directed to the semi-diurnal variation of gravity at a point on the earth's surface, due to lunar attraction and recently measured by Loomis. This temporal variation of g is much larger than the spatial differences measured by the Eötvos gravity balance, but it produces no effect on the balance. This constitutes an experimental proof of the power of the Eötvös instrument to discriminate between space and time changes of terrestrial gravitation ALLAN FERGUSON and J. T. MILLER The temperature variation of the orthobaric density of unassociated liquids. A formula connecting the orthobaric density of a liquid and its temperature is developed in the form $\rho = 2\rho_c[A\ (1-m)^{0\cdot 3}+(1-\frac{1}{2}m)]$, where m is reduced temperature and A is a constant which varies slightly from liquid to liquid, and may be taken to have a mean value 0 911 The formula is a long-range one, and has been tested for thirty pure organic substances It has been applied to the evaluation of expansion coefficients and to show the manner in which free and total molecular surface energy vary with temperature L C MARTIN : The *theory of the microscope* (2) A discussion of the effects in dark-ground illumination when the image of the source of light is projected into the object plane by an illuminator of the symmetrical type The treatment is two-dimensional. The conditions necessary for the formation of genuine and spurious images are investigated, and it is shown that the Abbe principle is theoretically valid in the cases considered A short practical investigation with Grayson's rulings supports the theoretical conclusions, but indicates the desirability of closer examination of the causes of misleading interference phenomena G GRIME Measurement of impact stresses in concrete A quartz piezo-electric gauge, using a cathode-ray oscillograph for recording, has been developed to measure impact stresses in concrete It is being employed to study the stresses in driven reinforced-concrete piles.

PARIS

Academy of Sciences, November 27 (*C.R.*, 197, 1257–1368) EMILE BOREL : Studies on the probability of series of rainy days or of fine weather. The analysis of 50 years' data, taken at Paris between October 1 and January 31, shows that given a run of either fine or wet days, there is a tendency towards persistence of the run (see also NATURE 132, 864, Dec 2, 1933) GEORGES CLAUDE : New progress in lighting by luminescence. The light emitted by neon-mercury lamps is known to be deficient in the blue region. The use of a coating of zinc sulphide has been suggested and the present communication describes a practical method for forming and fixing this coating Increased efficiency results, the tubes thus treated requiring 0 3 watts per candle instead of 0 4 in the usual type **Fred. Swarts**: The catalytic hydrogenation of trifluoracetic anhydride: trifluoralcohol Trifluoracetic anhydride is reduced by hydrogen under pressure (40–50 atmospheres) in the presence of platinum black, the reaction products being trifluorethyl trifluoracetate, trifluorethyl alcohol, trifluoracetic acid and trifluorethane. The methods of separation of these substances, together with their physical and chemical properties, are described **M Gignoux, L Moret** and **D Schneegans**. The geological structure of the gap of L'Argentière to the south of Briançon (Hautes-Alpes) **Maurice Fréchet** The coefficient known as the correlation coefficient **I Pétrowsky** The topology of real and algebraic plane curves **Gaston Vergnères** The unicity of the *minimum* distance from a point to an ensemble **Georges Bouligand** C M parallelism and parallelism in the classical sense **Bertrand Gambier**. Lines of connexion of surfaces. geodesic lines, umbilical lines, lines of curvature **Georges Kurepa** General separable spaces **Rosenblatt**· The application of Picard's method of approximations to the study of certain partial differential equations with real and multiple characteristics **N Adamoff** Some properties of the integrals of an equation of the second order with periodic coefficients. **Paul Flamant** Convergence and compacity in classes of (D) quasi-analytical functions **M Mursi** The values of the modulus of $\sigma(z)$ at infinity **Alex Véronnet** The complete evolution of a heterogeneous mass in rotation The impossibility of a division into two The figure of a heterogeneous mass in rotation, although not rigorously ellipsoidal, is nearly ellipsoidal Owing to the perfect continuity of the figures of equilibrium, it is impossible to explain the formation of double stars **Jacques van Mieghem** Dirac's system of equations and the equation of Jacobi **Albert Toussaint**· The corrections to be applied to the aerodynamical characteristics of a supporting wing, under experiment in a wind tunnel with rectangular air stream semi-guided by lateral walls, parallel to the spread of the wing **Ch Sadron** A new optical method of exploring a field of bidimensional velocities The method is based on the work of Maxwell regarding the double refraction presented by liquids in motion in the regions where the velocity gradient differs from zero With suitable precautions, the method proposed can be used to measure the velocity gradient up to a distance of the order of 0 1 mm. from the wall. **Max Serruys** Recording piezometric effects resulting from knocking in internal combustion motors. Four reproductions of records are given, one in normal working without knocking, three showing various conditions of detonation They show that detonation is produced at the end of the combustion and corresponds to the combustion of only a small proportion of the mixture The velocity of propagation of the detonating waves appears to be about 500 metres per second for normal compression (5 5 : 1). **Conrad Kilian** and **J Petit-Lagrange**· The probable course of the Tafassasset oued below the wells of In-Afellallah **J Tilho** Remarks on the preceding communication **Francis Perrin**: The materialisation of electrons during the collision of two electrons Various processes of annihilation of positive electrons **J. Géhéniau**: The L de Broglie waves in any gravific and electromagnetic field **A Guillet**. The stabilisation of the frequency n of the alternating current supplying a system. **L. Néel** The fluctuations of the molecular field and the magnetic equation of state of nickel **N Thon** Remarks on the theory of supertension of metals **Mme Branca Edmée Marques**. The fractional crystallisation of radiferous barium chloride **Yeu Ki Heng**. The influence of neutral salts on the rotatory power of α-phenylethylamine chlorhydrate **Mme. A Dobry** and **J. Duclaux** The viscosity of cellulose solutions It was suggested by J Duclaux and E. Wollman that the value of k in the Arrhenius formula is, as a first approximation, independent of the solvent, but this has been contested by other workers Calculating the coefficient k of Arrhenius to infinitely small concentration (k_0) it is now shown that the variations are small, the extreme values of k_0 for eleven solvents being 126 and 143 **Léon Guillet, *Jr.***. The modulus of elasticity of the α bronzes in the annealed condition The decrease in Young's modulus with increasing proportions of tin in the alloy follows a linear law to the first approximation. **Pierre Jolibois** and **Georges Fouretier** The crystalline analysis of unstable precipitates. **Mlle M L Josien** Contribution to the study of iodometric determinations **P Carré** and **D Libermann** The alkyl and aryl bromosulphites By the interaction of thionyl bromide on alkyl or aryl sulphites, bromosulphites can be prepared possessing the general formula RO SO Br **Mlle M Darmon** The preparation of phenylacetylcarbinol and of some of its other oxides **Henri Wahl** The chlorine derivatives of paraxylene. **Léon Enderlin**· Researches on the chemistry of the rubenes A colourless hydrocarbon with violet fluorescence derived from diphenylditolylrubene **Duquénois** The conditions of fixation of $HSbO_2$ by some aromatic monoacid monoalcohols β-Phenyl-α-lactic acid forms the best crystallised emetics and these are also less readily hydrolysed. Their stability is comparable with that of the tartaric emetics **Frèrejacque** The oxidation of uric acid in the presence of glycocoll By oxidation in a special manner described, salts of isoallantoylaminoacetic acid were obtained. **A Dauvillier**. The origin of atmospheric ozone Researches made at Scoresby Sound during the Polar Year **P Idrac**· The study of the internal movements of cloud masses by accelerated kinematography **L Herman** The absorption of ultra-violet radiations in the lower atmosphere **A Demolon** and **A Dunez** Bacteriophage and fatigue in soils under lucerne **Mlle M. L Verrier**. Researches on the visual field of the vertebrates. Determination of the field of vision of *Scorpæna scrofa* **G. Petit** Remarks suggested by the discovery of the skull of a cat in the sub-fossil deposits of Madagascar. The presence of this skull is in agreement with the hypothesis of human immigration into Madagascar from Africa at a very remote date **P Lassablière** and **A. Peycelon**: The comparative action of raw meat and of calves' liver on the general nutrition Raw meat proved to be superior to calves' liver in the general nutrition of dogs **Louis Baudin** Diurnal variations of the blood in fishes **Raymond-Hamet** Does oxyacanthine, the alkaloid of *Berberis vulgaris*, possess a sympathicolytic action ? **J. Risbec**: An enemy of *Brontispa froggatti* at the New Hebrides **E Brumpt**: Experimental fatal ascending paralysis of the dog due to the bite of the Australian tic *Ixodes holocyclus*. G. Ramon: Associated vaccinations. C. Levaditti, Mlles. R Schoen and Y. Manin, A. Vaisman: The presence of *Treponema pallidum* in the ovary of mice contaminated with syphilis

Sydney

Linnean Society of New South Wales, Sept. 27 W W. Froggatt The Coccidæ of the casuarinas. Twenty-eight species of the coccid fauna of the casuarinas are described or noted, five of the species being new. The new species belong to the genera *Gymnaspis* (1), *Eriococcus* (3) and *Pseudaripersia* (1). One genus is also described as new. E. C. Chisholm: Useful Coccinellidæ found on the Comboyne Plateau. Notes are given on eight species of Coccinellidæ which are of economic importance on the Comboyne Plateau Seven of these species are insectivorous and the eighth is vegetarian Ida A. Brown: The geology of the south coast of New South Wales, with special reference to the origin and relationships of the igneous rocks. The tectonic history from Cambrian (?) to post-Tertiary times, considered in relation to the building of south-eastern Australia, indicates that the south coast district was portion of a mobile borderland-massif until the close of the Middle Devonian, when it finally became a portion of the continental massif of Australia The history of igneous activity is closely related to the tectonic history, and, viewed broadly, supports Harker's generalisation of the association of sub-alkaline and alkaline intrusions with orogenic and epeirogenic earth movements respectively. An ultimately comagmatic origin for all the igneous rocks is suggested.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, January 15

Victoria Institute, at 4 30—(at the Central Hall, Westminster)—Capt B Acworth "Bird Flight and its Bearing on Evolution"

Royal College of Surgeons, at 5—Prof W E Le Gros Clarke "The Evolutionary Origin of Primates" (succeeding lecture on January 17)

Royal Geographical Society, at 5—Miss Cecilia Goodenough "Homesteading in North-Western Canada".

Tuesday, January 16

Eugenics Society, at 5 15—(at the Linnean Society, Burlington House, London, W 1)—"Safeguards in Eugenic Sterilisation"; speakers, Drs R Langdon-Down, E Mapother and C P Blocker *

King's College, London, at 5 30—Prof Felix Krueger "Work, Machines and Man" (succeeding lectures on January 18 and 19) *

Wednesday, January 17

Royal Microscopical Society, at 5 30—(Annual Meeting to be held in the B M A House, Tavistock Square, London, W C 1)—Conrad Beck "Some Recent Advances in Microscopy" (Presidential Address).

Television Society, at 7—(at University College, London, W C 1)—G Parr and T W Price "The Application of the Cathode Ray Tube to Television"

Royal Meteorological Society, at 7 40—(Annual General Meeting) Presentation of Symons medal to Sir Gilbert Walker

Prof. S. Chapman: "The Gases of the Atmosphere" (Presidential Address)

Royal Society of Arts, at 8.—J. M. Waldram: "Modern Developments in Street Lighting"

Friday, January 19

King's College, London, at 5.30—D. B Hoseason: "Apparatus for Power Factor Correction" (succeeding lectures on January 26 and February 2) *

Official Publications Received

Great Britain and Ireland

Safeguards in the Laboratory Compiled by the Science Masters' Association and Association of Women Science Teachers. Pp. 4. (Ely Canon Kirkland, King's School) 6*d*

The British Mycological Society Transactions Edited by J. Ramsbottom, B F Barnes and H Wormald Vol. 18, Part 3, 13 December Pp 189–256+plates 9–18 (London Cambridge University Press) 7*s* 6*d*

Proceedings of the Royal Society Series A, Vol 143, No A848, December 4 Pp 241 12*s* Series B, Vol 114, No B787, December 1 Pp 101–180 6*s* (London Harrison and Sons, Ltd)

Geological Literature added to the Geological Society's Library during the Year 1932 Compiled by the Library Staff Pp iv+306 (London Geological Society) 10*s*

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 73, No 444, December Pp 545–616+xii (London E and F N Spon, Ltd) 10*s* 6*d*

Philosophical Transactions of the Royal Society of London Series A, Vol 232, A715 On the Effect of the Temperature of Liquid Hydrogen (−252 8° C) on the Tensile Properties of Forty-one Specimens of Metals comprising (a) Pure Iron 99 85 per cent, (b) Four Carbon Steels, (c) Thirty Alloy Steels, (d) Copper and Nickel, (e) Four Non-Ferrous Alloys By Prof W J de Haas and Sir Robert Hadfield Pp 297–332 (London Harrison and Sons, Ltd)

Other Countries

Proceedings of the American Academy of Arts and Sciences Vol 68, No 11 The Lower Permian Insects of Kansas Part 6 Delopteridæ Protelytroptera, Plectoptera, and a New Collection of Protodonata, Odonata, Megasecoptera, Homoptera and Psocoptera By Frank M Carpenter Pp 411–503+1 plate 1 45 dollars Vol 68, No 12 Methods and Procedures used in the Massachusetts Institute of Technology Program of Investigation of the Pressures and Volumes of Water to 460° C, Part 1 By Frederick G Keyes Pp 505–564 1 20 dollars (Boston, Mass)

U S Department of the Interior Geological Survey Bulletin 849–E Mineral Deposits near the West Fork of the Chulitna River, Alaska By Clyde P Ross (Investigations in Alaska Railroad Belt, 1931) Pp viii+289–333+plates 25–27 15 cents Water-Supply Paper 656 Ground-Water Resources of Western Tennessee By Francis G Wells With a Discussion of the Chemical Character of the Water, by Francis G Wells and Margaret D Foster Pp vii+319+16 plates 60 cents Water-Supply Paper 729 Surface Water Supply of the United States, 1932 Part 4 St Lawrence River Basin Pp v+155 10 cents (Washington, D C Government Printing Office)

Memoirs of the Geological Survey of India Vol 62, Part 2 Vindhyan Sedimentation in the Son Valley, Mirzapur District By J B Auden Pp vii+141–250+x+plates 7–17 (Calcutta Central Book Depot) 5 4 rupees, 8*s* 6*d*

Records of the Geological Survey of India Vol 67, Part 3, 1933 Pp 249–356+plates 12–16. (Calcutta Central Book Depot) 2 12 rupees, 5*s*

Common Indian Trees and How to Know Them. By R. N Parker Pp iii+40+40 plates (Delhi Manager of Publications) 3 6 rupees; 5*s* 9*d*

The South African Journal of Science Vol 30 Being the Report of the Thirtyfirst Annual Meeting of the South African Association for the Advancement of Science, Barberton, 1933, 3 July to 8 July Pp xi+716 (Johannesburg) 30*s* net

Jamaica Annual Report of the Department of Agriculture for the Year ended 31st December 1932 Pp ii+40 (Jamaica Government Printing Office)

Kungl Sjökarteverket, Stockholm Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1930 Pp xvii+80 (Stockholm)

Smithsonian Miscellaneous Collections Vol 87, No 18 Sun Spots and Weather By C G Abbot (Publication 3226) Pp 10 Vol 89, No 10 Studies of American Species of Foraminifera of the Genus Lepidocyclina By Thomas Wayland Vaughan (Publication 3222.) Pp 53+32 plates Vol 89, No 11 Tertiary Larger Foraminifera of Venezuela By Donald Winchester Gravell (Publication 3223) Pp 44+6 plates (Washington, D C Smithsonian Institution.)

Ministry of Agriculture, Egypt Technical and Scientific Service Bulletin No 134 Water-ways as Vehicles of Infectious Diseases, affecting particularly Cattle in Egypt, and the Relative Sanitary Precautions By Prof Dr M Carpano Translated from the Italian by E Talarewitch Pp 8 (Cairo Government Press) 2 P T

Collection des travaux chimiques de Tchécoslovaquie Rédigée et publiée par E Votoček et J Heyrovský Année 5, No 11, Novembre Pp 457–502 (Prague Regia Societas Scientiarum Bohemica)

Japanese Journal of Mathematics. Translations and Abstracts, Vol 10, No 2, November Pp 83–132. (Tokyo: National Research Council of Japan)

Ibero-Americana 6: The Acaxee, a Mountain Tribe of Durango and Sinaloa By Ralph L Beals Pp iv+36 (Berkeley, Calif University of California Press; London Cambridge University Press) 35 cents

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Industrial Research

PARTICULAR attention is given to the work and position of industrial research associations in the annual report of the Department of Scientific and Industrial Research issued a few days ago The reason for this is that the fund of one million pounds granted by Parliament nearly sixteen years ago for the promotion of industrial research in Great Britain, through research associations, has now been exhausted, and the time has come for the whole subject to be surveyed, as well as for the consideration of a policy for the future When an industry is protected by a tariff, the State should demand in return that the industry is maintained in a condition of progressive efficiency , and this can only be achieved through continued developments of methods and processes Some large industrial concerns are in the position to maintain extensive research departments themselves , but if the existence of these establishments means that the co-operative work of the industrial research associations is left to smaller firms, and that some of the associations have to close down for lack of adequate financial support, the result, from a national point of view, will be unfortunate—to say the least

The Department of Scientific and Industrial Research was formed during the War as the result of a memorial from the Royal Society and other scientific and technical societies to the Government in May 1915 urging that assistance should be afforded "for scientific research for industrial purposes" In response to this appeal, a Committee of Council, presided over by the Lord President of Council, was constituted, with an Advisory Council of scientific men and industrialists The functions of this Council were . (1) To act as scientific advisers to all Government departments concerned with, or interested in, scientific research (2) With the co-operation of scientific societies, to consider the application of science to industry and enlist the interest of manufacturers (3) To advise the Board of Education as to steps which should be taken to increase the supply of workers competent to undertake scientific research

In the year 1917 Parliament placed a sum of one million pounds sterling at the disposal of the Committee of Council for the promotion of industrial research ; and a scheme was drawn up for the establishment of research associations connected with various industries, each of which was to receive for five years a grant on a fifty-fifty basis in aid of its expenses From the first, the guiding principle of the Department of Scientific and Industrial Research has been to induce the industries to do things for themselves rather than to attempt to do scientific work for them In the fifteen years during which the million pound fund was available, five thousand or so firms contributed £1,750,000 to the support of their industrial research associations, and there are nineteen such associations now in existence At present Parliament provides £65,000 a year and industry £170,000 towards the support of these associations Most of the associations have established their own research laboratories, but others have their investigations carried out at the National Physical Laboratory and in universities and similar institutions

The industrial research associations represent, however, only one side of the activities of the Department, which has also established a number of special stations on a large scale for building research, chemical research, food investigation, forest products research, fuel research, radio research, and water pollution research During the past year, seventy-six per cent of the expenditure of the Department has been used for these stations and thirteen per cent in support of industrial research associations

Although the Department has done a great deal to encourage fundamental scientific research in universities and other institutions, and is in close co-operation with the Royal Society, which receives an annual grant from the State in aid of purely scientific investigations, quite properly there has been no attempt to organise such research. Such a proceeding would be repugnant to the best research workers At the same time no expenditure has ever earned such big dividends for industry and for the community as the money spent on pure research One has only to think of such things as the modern electric lamp, the wireless valve and the photoelectric cell—products of pure research on atomic physics—to realise this. Although the majority of new knowledge which springs from fundamental research undoubtedly finds its application in industry, nevertheless the lag between scientific discovery and its use in industry has in the past been far too long.

Leaders of industry are finding that the methods followed by the men of science in approaching their problems can be followed with advantage in tackling many of the problems confronting modern industry The result of this during the last few years has been the organisation of research sections in many of the larger industrial concerns, and the formation of the industrial research associations to serve the interest of industries where the units of production are similar.

One of the best illustrations of the way that science is strengthening the chains of production is that of one of our oldest industries, the wool trade In the first place, wool is not a standardised raw material, many factors such as soil, climate, disease, gland secretions, food and management affect the quality of the wool The influence of all these factors on fibre qualities such as strength, diameter, elasticity and so on, which play an important part in manufacture, are being scientifically investigated Methods of controlling them are being sought with the view of reducing variations in the quality of the raw material. In the second place, the older methods of processing the wool, have, in the case of nearly all our older industries, been worked out without conscious planning The methods of science are therefore being applied in the technical improvement of these processes, and ways are being sought through the application of science for cutting costs and increasing efficiency.

The first of these two aspects of wool research concerns the big wool-growing countries, Australia and South Africa, and the work on these aspects is being carried out in Australia, for example, under the Commonwealth Department of Scientific and Industrial Research The link, however, between that work and inquiries seeking to discover how wool qualities are affected by feeding and by the soil, is the Wool Industries Research Association The Association has suggested that elasticity is directly connected with the sulphur content of the wool fibre. It has been found that sheep obtain sulphur in the form of a protein called 'cystine', and accordingly experiments are in progress overseas on the effect of extra cystine with the object of raising the sulphur content of the wool. Similarly fineness in the wool may be due to deficiency in phosphorus.

The same kind of link between the Empire grower and the manufacturer is maintained by the Shirley Institute, which is the Research Laboratory of the British Cotton Industry Research Association, where there is a staff of more than 200, of whom about 70 are fully qualified scientific investigators. The income of the Association is well over £50,000 a year, four-fifths of which is subscribed by the trade and the remainder by the Department of Scientific and Industrial Research Eighty per cent of the cotton firms in the country engaged in all parts of the industry from spinning to finishing are members of the Association The work of the Association has resulted in producing a large number of small improvements which altogether reach a substantial total. It has been calculated that a saving of something like £300,000 a year is being effected in Lancashire by the research carried out by the Research Association This gives a return of about 500 per cent on the money invested in research

One of the most productive researches ever carried out under the auspices of the Department depended mainly on the measurement of the conductivity of heat of soils and insulating materials. Cables distributing electric power in populated areas are, of course, put underground The electric currents naturally heat them, and the amount of current they can carry depends on the rate at which this heat is conducted away Accurate measurements on this point, carried out on behalf of the Electrical and Allied Industries Research Association, indicated that the heat conducted away was in most cases greater than had been supposed It was therefore shown that existing cables could be further loaded with safety to an extent representing a capital value in cables of £4,000,000

Related to this subject are investigations into the deterioration of lead sheath cables arranged by the Non-Ferrous Metals Research Association and carried out at the Research Department, Woolwich Lead sheath cables, though generally excellent in service, were found to suffer failures on board ship, in submarine and aerial cables where movements by tide or wind could occur, in railway service of bridges, in tunnels and, in fact, in all positions where they suffer exceptional vibration The breakdowns were very troublesome as the failure started from the inner part of the sheath and could not be seen until a complete breakdown of the sheath took place The cause was investigated by the Research Association, which was able to produce two new ternary alloys of lead containing lead-cadmium-antimony and lead-cadmium-tin which have a fatigue resistance three and a half times as great as the ordinary pure lead. These alloys have solved the problem with regard to the deterioration of lead cable sheathing. It may be remarked that 80,000 tons per annum are used in Great Britain for this purpose and in the United States one company alone uses 75,000 tons of lead for the sheathing of telephone cables. The new alloy is used on the new Post Office submarine telephone cable to France. In addition to this better fatigue resistance, the new alloy is also at least fifty per cent stronger than pure lead in other respects, and it is therefore likely that it will have a great future for improved water pipes

These examples selected from recent reports illustrate the bearing of scientific research upon industrial progress and commercial profits It would be easy to advance many others to show that scientific research should be looked upon not as a last resource but as an essential part in the business of production It is now generally recognised that the initial advantages which Great Britain secured through her island position, her natural resources, and the technical skill of her workers, are no longer sufficient in themselves to enable our manufacturers to withstand the organised and scientific rivalry of competing countries The full utilisation of the results of scientific research, and the substitution of scientific for empirical methods can, however, only be secured as a result of confidence in the scientific workers engaged in the study of the problems concerned and of acquaintance with the existence and value of this large body of scientific knowledge and research

Although scientific methods are much more widely used in almost all our industries than even a few years ago, there is not yet a general disposition to accept an adequate and sustained programme of research as a fixed charge, comparable with insurance, depreciation, obsolescence, etc, without which no industry can progress, if indeed it can survive Science, whether in its broadest aspect or its narrow technical sense, will not occupy its proper place in industry until the industrialist is prepared not merely to admit its possibilities and accept its occasional assistance but also to incorporate it as part of his industrial practice Such incorporation involves not merely the support of research work, whether conducted in his own laboratories or outside, or in co-operation with other firms, but also continuous contact with research in matters of interest to his industry, wherever that research is prosecuted.

With such convincing records as those mentioned in the report of the Department, of the financial advantage and public benefit derived from scientific research, particularly in the province of electrical engineering, it would seem to be unnecessary to urge that electrical manufacturers and supply companies might reasonably be expected to devote a fraction of one per cent of their profits to research, whether in university laboratories or by co-operative effort Leaving purely scientific investigations out of consideration, there are many technical problems awaiting solution, and great savings and economies may be confidently anticipated from systematic research into them, yet the funds provided to the British Electrical and Allied Industries Research Association for such work are a very poor return for benefits received or belief in favours to come The annual revenue of the electric supply authorities in Great Britain is about £45,000,000, and so far their annual contribution to the funds of the Association has only reached about £5,000, though they are benefiting by research done or nearing completion to the extent of a sum approaching £1,000,000 per annum If the public attention given to the recent report of the Department of Scientific and Industrial Research should lead to a wider understanding and more generous recognition of both scientific and industrial research from manufacturers and corporations who profit by the results, it will have achieved a most useful national purpose

Numbers and Numerology

Numerology By Prof E T Bell Pp vii + 187 (Baltimore, Md The Williams and Wilkins Co , London Baillière, Tindall and Cox, 1933) 11s 6d

"EVERYTHING is Number !" Thus spake the son of Mnesarchus Ever since these words were uttered, not only have philosophers vied with each other to find a correct interpretation of them, but also the world has turned its back to the fact-finding approach to human affairs and still enjoys the rhetorical approach of numerology Pythagoras was thus the founder of esoterism and arithmosophy as well as of science and philosophy If the number of followers of any particular doctrine are to be taken as a criterion of its value, then esoterism and arithmosophy may well be given the palm

The predominance of number in the world of appearance is obvious Ancient religions and ancient philosophies recognise a quantitative order in the universe, whatever be their conceptions about its origin The rhythm of life, the rhythm of Nature and the rhythm of the heavens have always appealed to the imagination of man Number and proportion, its subtler aspect, dominate the practical arts of man Without number, there would be no commerce, no architecture, no medicine, no religious cults, and none of the crafts appearing between these landmarks of human interests This profound truth must have been revealed to Pythagoras by the sages of the East with whom he came into contact, and was probed by his own observations and meditations For example, his exaltation in submitting the imponderable vibrations of sound to the law of number, inspired him with his famous doctrine of the harmony of the spheres, when he dogmatically imposed certain numerical proportions between the celestial bodies and their movements It is this Pythagorean spirit which Plato inherited, as is shown in the "Timæus", where he builds up the universe by means of numerical proportions and geometrical figures, a process which culminates in the construction of the five regular solids Moreover, we believe it is not far from the truth to assume that Euclid himself had a Pythagorean vision before him when he wrote his everlasting "Elements" It is significant to observe that his thirteen books end with the construction of the regular solids, as if their author were not interested in the other types of curves and solids already known in his time, once he had given to the world the rational steps leading to the understanding of the wonderful figures with which Plato had created the soul and the universe

This spirit, dormant during the Middle Ages, which were more interested in ethical numerology, becomes supreme again during the Renaissance The mathematisation of astronomy by Copernicus and Kepler, and the foundation of modern mechanics by Galileo on the firm ground of number, were in the best Pythagorean tradition So also was the establishment of analytical geometry by Descartes, a new science which may be considered as a refined form of the arithmetical geometry of Pythagoras Again, the invention of the calculus by Newton and Leibniz gave the man of science new tools for combining his mathematical picture of the universe Ever since, not only have astronomy, physics and chemistry come more and more under the influence of the law of number, but also biology, psychology and sociology Indeed, the most comprehensive thought ever conceived by man is short the cosmos is isomorphic with pure mathematics , an obvious generalisation of the old Pythagorean saying that everything is number At present, we do not know whether it is a great though simple truth or whether it is just nonsense. But we cannot turn our backs on it, though theories are brought forward and discarded with disconcerting speed. In this respect, one may quote the case of Lord Kelvin, who endeavoured to paint one grand inclusive picture of the physical universe which would tell the whole story for ever, the only occasion when he shocked his followers was towards the end of his life, when he summed up his long search by describing it as a failure Yet the same spirit pervades the younger generation, with the difference that instead of trying to construct dynamical models of the universe, they content themselves with purely mathematical maps If a set of differential equations correctly describes the electromagnetic field, why look further? So we are told by Sir James Jeans that God himself is a pure mathematician

If men of science profess such a divine consideration for mathematics, why not allow other types of number-worshippers to discover some numerical relations in the world of ethics and religion? The Pythagoreans maintained that virtue, as well as health, is a harmony obeying certain numerical proportions Justice is also a reciprocal proportion, and friendship is a relation of equality, a belief illustrated by the 'amiable numbers' which are such that each is equal to the sum of the aliquot parts of the other It is considerations of this kind which inspired the systematic researches of cabbalism, occultism and onomantic astrology We ought not to laugh at such beliefs even to-day, more people believe in lucky and unlucky numbers than in the mathematical expression of the external world

The belief that mathematics can explain everything seems to be due to the fact that it has always been considered as the simplest and strongest manifestation of reason So that, if the world is rational, then by studying mathematics in itself, the intellect penetrates more and more into the essence of things. This faith in the power of mathematics has been increased of late, with the growing assimilation of mathematics to logic But then, how can one explain the reason of so many failures in science and of the general inconclusiveness of numerology? The difficulties in both cases are similar to those which account for the failure of primitive Pythagorism. In the simple figure of a square, the Master himself could not find a common measure, a number, between its side and its diagonal If everything is number, how then can we explain the impossibility of finding a number expressing the relation between these two lines? No wonder the discovery of these 'irrationals' was kept secret in the inner ring of the Italic school, and their revelation cast doubts on the leadership of the Master. Thus number which caused the greatness of the Pythagorean order, also caused its breakdown The efforts of the later mathematicians, and of Plato himself, tended to integrate the 'irrationals' into a comprehensive system of thought Thus we soon had a theory of the 'irrational quantities' established by Theodorus of Cyrene, a theory of 'negative quantities' added by the Renaissance, and the 'infinitesimal quantities' invented by the seventeenth century in its endeavour to follow Nature as closely as possible. Still unable to exhaust Nature numerically, the nineteenth century thought of 'imaginary quantities', and we have had since such extraordinary conceptions as the 'ideal numbers' and the 'transfinite numbers', to which even mathematicians take exception Whence Kronecker's aphorism "God has created the integers, and everything else is human"

In this race towards the understanding of Nature, of man, of the universe as a whole, can we hope that number will overtake all the difficulties lying on its path? We doubt it; for numbers cannot identify themselves with human thought and human will, which give them meaning and practical application On the other hand, however true may be Leibniz's aphorism "Dum Deus calculat fit mundus", we cannot be so vain as to pretend that the mathematical mind of God and the mathematical mind of man are identical. That is why one is forced to admit, in the universe, the existence of an irrational element, the existence of pure qualities, which are as yet beyond any mathematical expression, not to mention, of course, the impossibility of expressing mathematically existence itself

Such and similar thoughts are suggested by the reading of Prof. Bell's interesting monograph on "Numerology", in which, without apparently taking sides, he is rather sceptical as to the value of the real claims of numerologists. The amusing stories and examples he quotes, as for example, the 'beasting' of people through the correspondence of their names with numbers, would naturally appear, to an orthodox mathematician, as added arguments in favour of that scepticism.

THOMAS GREENWOOD

Physiological Balance in the Body

The Wisdom of the Body By Prof. Walter B Cannon Pp 312. (London Kegan Paul and Co, Ltd, 1932) 12*s* 6*d* net

BOTH because of the vivid interest of its subject matter and also the simple and clear way in which it is written, this recent book of Prof Cannon should make a ready appeal to a wide circle of the general public as well as to students of the biological sciences It is the fourth of a series of volumes giving the conclusions of the researches he and his colleagues have been carrying out over a period of more than thirty years The first of these, published in 1911, was concerned with the mechanical factors of digestion, but it included also chapters on the nervous control of the digestive process, and the effect of emotional states upon it The second work (1915) was his well-known "Bodily Changes in Pain, Hunger, Fear, and Rage", which stressed the importance of adrenal secretion in connexion with the many somatic changes that occur in emotional excitement The third, "Traumatic Shock" (1923), dealt with the general functions of the autonomic nervous system, and was mainly a war-case study The present volume carries the same general line of study a step further, treating, as it does, of the relation of the autonomic system to the balance (or, as he terms it, homeostasis) of physiological processes

The main part of the book is devoted to showing how, in the blood, the safeguarding of homeostasis in respect of water, salt, sugar, proteins, fat and calcium is brought about, how an adequate oxygen supply is maintained during states of relative passivity and active endeavour, how acid-alkali neutrality is secured, and how body temperature is kept within normal limits All this may sound technical and uninteresting, in point of fact it makes fascinating reading When one realises that the elements of the human body live in an internal environment the character of which must be maintained in order that they, and it, may live, not only are the mechanisms which secure the constancy of that environment, the 'fluid matrix', of supreme importance, but also our knowledge concerning them is of supreme interest Chapters follow on the natural defences of the organism, the margin of safety in bodily structure and function, the divisions of the nervous system, and the part that the sympathetic-adrenal system has to play in homeostasis.

Prof Cannon is careful to show where he is stating ascertained fact and where making use of conjecture, thus at once attracting the layman by the candour of his science and suggesting fresh fields of experiment to the biological worker.

The volume ends with a summary of the general features of bodily stabilisation, and an epilogue dealing with the relations of biological and social homeostasis. The title of the book, borrowed from the late Prof. Starling's Harveian oration of 1923, aptly and picturesquely describes its content It is science, but it reads like a poem.

Tables of the Planets

Planetary Co-ordinates for the Years 1800–1940 referred to the Equinox of 1950 0. Prepared by H M Nautical Almanac Office Pp xviii+156 (London H M Stationery Office, 1933) 12*s* 6*d*. net

IT is not too much to say that the appearance of this volume will be joyfully welcomed by all astronomers who devote their attention to the calculation of planetary and cometary orbits, taking account of the perturbations by the major planets Of late years the advantage of using rectangular co-ordinates, as in the methods of Encke and Cowell, has been more and more appreciated, first because of their greater simplicity, and secondly because of their adaptability to machine-calculations A further advance towards simplicity and economy in arithmetical work consists in the choice of a standard equinox to which the co-ordinates of planets, etc, are referred so as to cover the needs of two or three decades In this volume, the mean equinox for 1950 0 has been selected The advantages of using a standard equinox had been pointed out by Dr L J Comrie some years ago, and it is satisfactory that a proposal of this kind has now been translated into an accomplished fact

The tables of the planets give the heliocentric longitude and latitude, the radius vector (with its logarithm), the heliocentric rectangular equatorial co-ordinates and the rectangular components of the attraction on the sun, all at intervals of 10 days from 1920 until 1940 and referred to the equinox of 1950 0 In addition, these quantities for Jupiter and Saturn are extended backwards to 1900 and the co-ordinates of Uranus and Neptune to 1903 The ecliptic co-ordinates for Jupiter and Saturn are also given at intervals of

100 days from 1800 to 1900 The latter data will enable computers to connect up earlier apparitions of comets or oppositions of minor planets An innovation, which will commend itself to workers in this field of astronomy, is the expression of angular co-ordinates in the decimal division of the degree

There are fifteen subsidiary tables dealing, *inter alia*, with the mean obliquity, ecliptic and equatorial precessional elements, the reduction of equatorial rectangular co-ordinates from one equinox to another, the reduction of star positions, interpolation coefficients and the general formulæ on which the computation of orbits is based

A fully worked out example—the work of Miss Julie Vinter Hansen of Copenhagen Observatory and Mr D H Sadler of the Nautical Almanac Office—in computing perturbations is given in the introduction In addition to illustrating the methods of computation, it affords a practical comparison of the relative merits of the methods of Encke and Cowell

It should be added that the tables have been prepared under the direction of Dr L J Comrie, superintendent of H M Nautical Almanac Office, who must be congratulated on producing a work of such importance to dynamical astronomers

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Meteorological Science and Art

The Drama of Weather By Sir Napier Shaw Pp xiv +269 (Cambridge At the University Press, 1933) 7*s* 6*d* net

SIR NAPIER SHAW begins this book with a prologue on "Pageantry in the Sky" in which a vivid idea is given of the beauty and wonder of the pictures formed by clouds. The pairs of stereoscopic pictures are particularly to be commended in that the distance separating them is small enough to permit of their enjoyment without the need of optical equipment

We next have the "Ideas of the Drama Ancient and Modern" and trace the gradual advance through magic, witchcraft and astrology The development has closely resembled that of medicine, with which meteorology was formerly united under the care of the 'medicine man' The two sciences have much in common ; the principles of diagnosis and prognosis are alike and, as the author remarks, in weather "the processes of digestion have their counterpart, but here the analogy becomes a little too intimate". When dealing with the demand for forecasts, which has become far more insistent with the spread of wireless telegraphy, Sir Napier Shaw considers that in forcing the meteorologist to pronounce an opinion which cannot always be correct "the stress of service has hampered the progress of science" But he seems to overlook the enormous stimulus to investigation and the increase of financial provision that are the direct outcome of the demand.

In Chap ii we read of "The Watchers What They See and What They Say" The watchers are the meteorological factors—winds, pressure, etc , some too little known weather toys fascinate us for a time and we learn something of the enormous bulk of the collections of data which form "the book of the play"

The chapter devoted to "The Score" shows how observation can be used to provide "a summary of the action of the play and to suggest leading motives for the sequence of events in the weather's arena" There is an admirable collection of diagrams showing different ways of exhibiting variations both in time and in geographical position Effort is undeniably well spent in effecting pictorial representations which will cause to leap to the eye features which would escape notice when buried in masses of numbers : and the author's ingenuity in this respect is well known. As an example may be taken the method of showing the amounts of seasonal transfer of air over the earth, there being ten million million tons less over the northern hemisphere in July than in January

Chap iv is headed "The Chorus Rhythmic Aspects of the Records", and contains an interesting series of contrasts between the periodic variations of the elements and the occasional freaks produced by external, and apparently capricious, interference Sir Napier rightly points out that most periods have such small amplitudes as to exercise but trivial influences on the rainfall of any particular season but this remark is not applicable to all seasonal relationships, and it seems unduly pessimistic to observe that it may "be best to regard our coefficients as poetic illustrations of the meaning of our facts and not as substitutes for them"

The last chapter and the epilogue deal with the weather map and the history of daily forecasting. We read of the disappointment that followed the introduction of Abercromby's ideas, and of the success of Norwegian methods perhaps the size of the book explains the absence of allusion to

Austrian methods of explaining the associated variations in the upper air in terms of its northern or southern origin

Those who know Sir Napier Shaw's other writings will find fulfilment of their expectations of wealth of imagination, crispness of style, love of paradox and freshness of outlook He has played a big part in the creation of the international organisations on which meteorology largely depends for its practical efficiency, and he has always been a fighter, with much disinclination to sit on the fence, so that he takes pleasure in vigorous strokes rather than in delicate expression of slight differences

The advance of science is in some respects like that of a vessel in misty weather The landmarks are hard to make out until somebody has picked them up, and after this they are obvious accordingly there is great value in a book which stimulates thought Although the present work will be intelligible as well as attractive to the layman with some slight knowledge of physics, its suggestiveness and its style alike recommend it to the specialist as worthy of careful perusal G T W

Short Reviews

Handbuch der Geophysik Herausgegeben von Prof Dr B Gutenberg Band 2, Lief 3 *Die Erdoberflache*, von Erwin Kossinna, *Petrographischer Aufbau der Erdkruste*, von Dr S Rosch, *Chemie der Meteoriten*, von Prof G von Hevesy Pp 869–1119+xv 42 gold marks Band 4, Lief 4 *Die zeitliche Folge der Erdbeben und bebenauslosende Ursachen* Von Prof Dr V Conrad Pp 1007–1202+xii 39 gold marks Band 7, Lief 1 *Das Eis der Erde*, von Prof Dr H Hess, *Seen*, von Prof Dr W Halbfass, *Das unterirdische Wasser*, von Prof Dr W Koehne Pp v+252 42 gold marks (Berlin Gebruder Borntraeger, 1932)

FEW readers, and even few authors, of papers on periodicities in the occurrence of earthquakes have taken the trouble to compare the amplitudes they obtain with those that would be expected to arise from the harmonic analysis of a purely random set of observations Prof Conrad has done a great service in collecting the results and testing them in all cases by means of the Schuster criterion Most of the suggested periodicities turn out to be probably not significant, on the ground that they would be just as striking if the observations were arranged in any other order in time instead of the actual one, Turner's 21-minute period is among these The possible survivors are the diurnal and annual periods, and perhaps a 14-monthly one The curious thing about the first two is that they are conspicuous in felt shocks, but not in instrumental ones This suggests that they may be the result of differences between the conditions of observing by day and by night, but then why should the phase vary conspicuously from place to place? Why should it be opposite in some parts of Japan from others?

There is a regularity in the frequency of aftershocks from a great earthquake, the number per unit time falling off according to a hyperbolic law This suggests a relation with the mechanism of elastic afterworking

The price of 42 gold marks for an unbound part of 252 pages is a poor service both for the authors and the reader. H J

British Wild Flowers By Louis Johnstone First Series 16 plates+16 diagrams Second Series 16 plates+16 diagrams *British Trees* By Barbara Briggs Second Series 16 plates+16 diagrams (London The Lutterworth Press, 1933) 3*s* 6*d* net each set

THE biologist always looks askance at "beautiful coloured plates" of biological material, for, unlike the hand paintings of flowers housed at Kew, scientific accuracy is almost invariably either disregarded or masked in the striving for artistic effect None of these series of coloured plates, however, should be placed in the usual category of coloured diagrams of plant and animal subjects In general, they are very accurate, and though they show little but the identity and general structure of the plants they portray, they are to be highly commended, since all the plants are pictured on a background representing their normal habitat There is little fault to find with accuracy in this connexion, except that few botanists would agree that the usual habitat of the white deadnettle is "ruins and rocks"

In each of the two series of wild flowers, 135 species are represented In the series of trees, each tree occupies one plate The usefulness of all three series is enhanced by a collection of line diagrams accompanying each plate, where details of such diagnostic features as flower, fruit, leaf, winter bud, etc, are given

The plates can be highly recommended, for reference purposes, to teachers of elementary nature study and botany, also, they are so attractively done that they would decorate the classroom, laboratory or museum wall.

Mathematical Facts and Formulæ By A S. Percival Pp v+125 (London, Glasgow and Bombay Blackie and Son, Ltd, 1933) 4*s* 6*d*. net

To fill a notebook with the formulæ that happen to have been of most use to himself and the comments that he has found most illuminating is a pleasant and profitable task to anyone who performs it, but the result cannot have value of a comparable kind to any reader. To say that it is hard to know to whom to recommend Mr Percival's discursive jottings, which range from the multiplication of polynomials to the solution of partial differential equations, is not to deny that some of his remarks were worth making. On the other hand, the teacher who expects a protest against the prevalent inaccuracy in presenting the integral of $1/x$ will be disappointed to find only the usual formula, and inverse circular functions are said to be essentially acute angles.

The one surprising feature of the book is a six-figure table of log $\Gamma(x)$, from 1 to 2 at interval 0·001. There are only two substantial mistakes, and these would be patent in use: against 1·255, for 6854 read 6834, and against 1·529, for 8274 read 8174. Perhaps, however, the first row would puzzle an inexperienced user, and when the seventh digit of the Smithsonian table from which he was extracting was a 5, Mr Percival adopted some rule of thumb instead of looking elsewhere for a closer approximation, and fifty entries are at fault by a unit in the last place for this reason.

E. H. N.

Men without Money: the Challenge of Barter and Scrip. By Wayne Weishaar and Wayne W. Parrish. Pp. x+111. (New York and London: G. P. Putnam's Sons, 1933.) 5*s.* net.

THE severity of the economic depression in the United States has led to the introduction of barter on a considerable scale, and this book provides a vivid record of a remarkable movement in which about a million persons are participating. The simplest form described is that in which commodities or services are directly exchanged against each other by farmers, dentists, barbers, shopkeepers, doctors, artisans and labourers. Direct barter, however, is limited, since a double coincidence of wants may be lacking. To meet this difficulty, exchanges have been inaugurated to act as clearing houses. One such exchange, for example, found a farmer in Syracuse who was willing to take shirts and shoes for his grain. This was exchanged with a poultryman for eggs and fowls which in turn were traded with restaurants to provide meals for workers engaged in making shirts for the farmer.

Many of the exchanges issue 'scrip' or tokens which circulate as a kind of local money. Certain municipalities have also issued 'scrip' to the unemployed in return for work on the roads. To prevent debasement, this scrip has to be stamped at every transaction, thus building up a fund for its eventual redemption by the municipality.

Sacraments of Simple Folk. By R. R. Marett. Pp. vii+230. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 10*s.* net.

IN the second series of his lectures on the Gifford foundation delivered in 1932–33, Dr. Marett studies the function of the sacrament in natural religion, that is, as he understands it, in the religion of primitive peoples. A sacrament is defined as "any rite which by way of sanction or positive blessing invests a natural function with a supernatural authority of its own". This definition is tested in the course of the lectures by the study of particular instances among the diverse activities of savage life. Ritual, instead of a deadening, is shown to be a vitalising force, bringing emotion to the support of reason in promoting right action, these terms in this context, naturally, being used in a relative sense.

It will be seen that Dr. Marett's point of view in his analysis of primitive institutions and their ritualistic accompaniments is both psychological and sociological, while he applies a formula to the behaviour of primitive peoples which is equally applicable to that of more advanced civilisations. This, however, is an aspect of his inquiry to which Dr. Marett makes only incidental reference. It should not, however, be overlooked, lest the broader view of anthropological studies be forgotten.

The Progress of Man: a Short Survey of his Evolution, his Customs and his Works. By A. M. Hocart. Pp. xvi+316. (London: Methuen and Co., Ltd., 1933.) 7*s.* 6*d.* net.

"LIVE man," Mr. Hocart says, "wants to know about his past as a key to his present. The man who does not is dead." He has written what is virtually a survey of the material of anthropological science to satisfy that desire. An enormous amount of ground is covered in a small compass; for he has traced the growth and achievement of man "from the time he can be reckoned as man" down to the present day. Mr. Hocart will have none of the arbitrary divisions between prehistory and history, and between savage and civilised. His treatment of the subject is individual in style and original in method; and be it added, at times provocative. It is not possible to comment here in detail upon the many points upon which his views stimulate thought; but attention must be directed to the emphasis he lays on the psychological and ritualistic element in mechanical invention. His protest against the misuse of 'evolutionary' in the study of technical development is salutary.

Network Synthesis: Synthesis of a Finite Four-Terminal Network from its Prescribed Driving-Point Functions and Transfer Function. By Dr. Charles Mason Gewertz. Pp. vi+257. (London: Baillière, Tindall and Cox, 1933.) 23*s.*

THIS work is an interesting exercise, and its subtitle is accurate. The main title alone, however, is quite misleading, for the reader who goes to this book for a general and comprehensive treatment will find that he must first go elsewhere for the foundations on which the author builds, and in the end he will probably conclude that empiricism is sometimes cheaper than pure reason.

The John Murray Expedition to the Arabian Sea

By LIEUT-COL R B SEYMOUR SEWELL, C I E

THE John Murray Expedition has now completed its first three months' work, during which time the H E M S *Mabahiss* has made four cruises, each of approximately three weeks' duration, namely, (1) down the Red Sea and round the head of the Gulf of Aden between Perim and Aden , (2) around the Gulf of Aden and out into the Indian Ocean to the south-east of Socotra , (3) along the southern and south-eastern coast of Arabia , and (4) up the Gulf of Oman We have thus completed our programme of work across the northern part of the Arabian Sea and have carried out observations at 90 stations, of which 18 were in the Red Sea and the Straits of Bab el Mandeb, 20 in the Gulf of Aden or to the south-east of Socotra, 27 along the coast of Arabia, and 25 in the Gulf of Oman and its approaches Of these stations, 15 have been 'complete' ones, including both physico-chemical and biological observations , at 41, physico-chemical observations only have been made , trawls or dredges have been carried out at 37 , and at 8, observations have been made with the Priestman grab

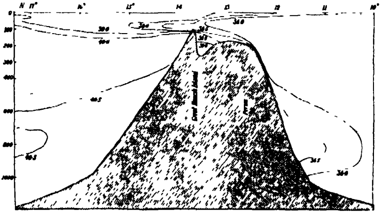

FIG 1 Salinity of the water in the Straits of Bab el Mandeb (*Depths in metres*)

TOPOGRAPHY AND BOTTOM DEPOSITS

Thanks to the installation of the echo-sounding machine, we have been able to carry on an almost continuous survey of the bottom during our four cruises In the Red Sea we were able to confirm the presence of a deep area having a depth of 2,204 metres (1,205 fathoms) in lat 25° 24′ 12″ N , long 36° 12′ 12″ E The bottom in the deeper levels consists largely of a rock, or coarse gravel, containing a high percentage of calcium carbonate, that appears to be forming *in situ*

We have three times traversed the Gulf of Aden along its whole length and have been able to detect the presence of no less than ten definite ridges that run obliquely across the northern and central parts of the Gulf in a north-east to south-west direction, the more westerly ridges showing a tendency to curve westwards We have not yet been able to define the most southerly limits of these ridges, but we hope to do so during our return journey in April next

Along the Arabian coast, throughout the area that we have investigated and extending from Ras Nus, the western headland of Khorya Morya Bay, to Ras al Hadd at the eastern extremity, the coast line is for the most part composed of high vertical, or in some places even overhanging, cliffs, some of which rise to a height of 600–800 ft and are composed of a stratified sandstone alternating with horizontal bands of a harder material or limestone A similar formation is also to be found on the Khorya Morya islands, though some of the steep hills are composed of granite To seaward there is a broad, gently-sloping shelf , but at or near the 50 fathoms level the sea-floor drops with great rapidity and is very irregular, running out in a complicated series of submarine promontories, between which are deep gullies Much of this bottom consists of rock that played havoc with our nets On one occasion we brought up in the dredge from a depth of 1,416 metres (774 fathoms) a half to three quarters of a ton of angular granite blocks of various sizes, without any trace of associated sand or mud, constituting a definite scree slope, and there can be little doubt that the whole coastline is part of a large geological fault

Where not composed of rock, the bottom consists of a brown or green mud, and towards the eastern end in the neighbourhood of Ras al Hadd this green mud smells very strongly of sulphuretted hydrogen Six observations showed that this is present between the depths of 95 metres and 1,253 metres, though most strongly marked at 421–457 metres, the occluded water from a bottom-sample at 421 metres containing as much as 29 39 milligrams of sulphuretted hydrogen per litre This occurrence of sulphuretted hydrogen in the bottom deposit affords a parallel to the condition found in the Black Sea and in some of the enclosed fjords, but its presence along an open seacoast was scarcely to be expected and its cause must at present remain unsolved. A very similar mud bottom, composed of green mud, or in the deepest depths of a grey clay, but not impregnated with sulphuretted hydrogen, is found throughout the whole of the Gulf of Oman and along the coast of Makran and Baluchistan below a depth of about 250 metres.

Between Ras al Hadd and the Indian coast in the neighbourhood of Karachi the echo-sounder has clearly revealed the presence of a submarine ridge that runs westward towards the entrance to the Gulf of Oman more or less parallel to the hill ranges of Baluchistan and Makran. To the south of this ridge and separated from it by a level plain with a fairly constant depth of 1,850 fathoms (3,383 metres) lies a second ridge that runs towards the south-west, and immediately to the south-east of this is a deep gully, bounded in its turn by the edge of a plateau that slopes gradually downwards towards the south-east. The bottom of this gully lies 2,000 fathoms below the sea surface and its general character reminds one strongly of a river bed. Have we here the now submerged bed of the Indus, where it flowed out into the Arabian Sea at a point more to the north of its present mouth or, possibly, the mouth of the great Indo-brahm river, the existence of which was postulated by Pascoe and Pilgrim ?

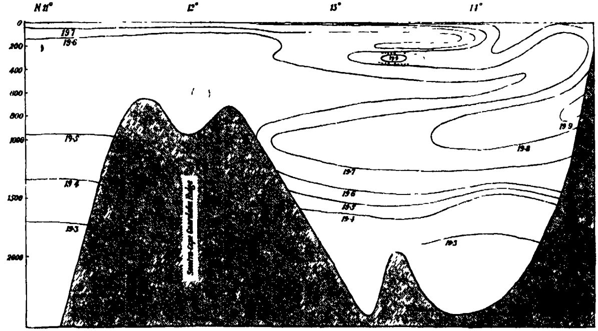

FIG 2. Halogen content of the water of the Socotra current

PHYSICO-CHEMICAL RESULTS

The physico-chemical examination of the sea-water of the Red Sea at all depths between the surface and the bottom indicates that there is in all probability a vertical circulation going on between a depth of 200–300 metres and the bottom, for at a depth of about 400–500 metres the temperature and both the halogen- and oxygen-content of the water are at a minimum and exhibit a clear increase in passing either upwards towards the surface or downwards to the bottom. We hope to carry out further observations on this point during our return journey.

On our way through the Straits of Bab el Mandeb a series of observations was made on the character of the sea-water and the fauna of the shallow channel that connects the Red Sea with the Gulf of Aden. There were indications of at least three different strata of water in the Straits, of which the uppermost was flowing out of the Red Sea, while the second and by far the largest of these water masses was flowing into the basin between the depths of 70 metres and 160 metres. The lowest stratum, namely, that of the bottom water of the Red Sea, was extremely small or even non-existent and scarcely passes over the sill near Great Hanish Island (Fig 1). This condition of the water movements affords a marked contrast to the results obtained by the *Magnaghi* (1924) and the *Ormonde* (1927) in the months of April and May (*vide* Schott[1]). At this latter season of the year it is the outflowing bottom current and not the inflowing current that is the chief characteristic.

A number of serial observations on the sea-water in the Gulf of Aden have shown that there is in the Gulf a very complicated system of deep currents, and this is especially the case at the eastern end, where the "Socotra" current, to which Matthews has directed attention[2], sweeps northwards, partly through the gap between Cape Guardafui and Socotra and partly to the east of the island. A series of five stations running from south to north were made across this part of the Gulf and the results obtained indicate a deep and complicated vertical rotation of the water masses (Fig 2).

At three places along the Arabian coast, lines of stations were run in order to detect, if possible, any upwelling of cold antarctic bottom-water, but so far as our observations go, there was no sign of any such phenomenon On two occasions, off Ras Sukra and Ras Madraka, at the two ends respectively of Sukra Bay, there was a definite fall in the temperature of the surface water by as much as 2 5°, this apparently was not due to the upwelling of deep water, but was probably caused by water upwelling from only moderate depths under the influence of the tidal currents

In the Gulf of Oman (Fig 3), our observations indicate that whereas there is an outflowing current that extends from the surface down to some 30–70 metres and a second similar current extending from 125 metres down to 350 metres on the northern and 500 metres on the southern side of the Gulf, between these two layers there is a stratum of inflowing water that can be traced up the Gulf as far north as Station 71 (lat 25° 35′ 00″ N, long 56° 42′ 18″ E) The bottom water, the upper limit of which lies at a depth of some 350 metres on the northern side and at about 500 metres on the southern side in the vicinity of Muscat, appears to be an offshoot of deep Indian Ocean water that is moving northwards into the Gulf through the gap between Arabia and the Karachi plateau, to which I have already directed attention

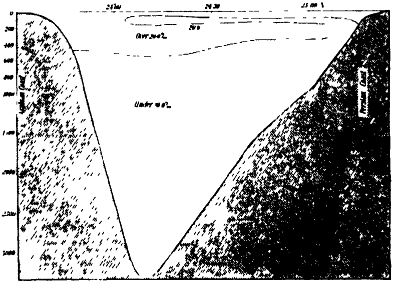

FIG 3 Halogen content of the water across the Gulf of Oman in the region of Muscat

BIOLOGICAL OBSERVATIONS

On the biological side, two areas have proved to be extremely interesting—not because of the richness of their fauna, but, on the contrary, because of its paucity or even complete absence The first is the deep part of the Red Sea During our cruise down this region in September, we carried out several trawls and dredges in depths ranging from 55 metres to 1,167 metres, and in four hauls in depths below 200 metres we were unable to detect any sign of living organisms on the bottom, which, as already mentioned, consists of a calcareous rock that appears to be in process of formation *in situ* In view of the enclosed character of the basin, the depth of the entrance channel at Great Hanish Island just to the north of the Straits of Bab el Mandeb being only some 160 metres, the water of the Red Sea below this depth, as is well known, has a very high salinity (40 per mille and above) and a high temperature (22°–23° C), though the oxygen content of the bottom water is higher than we expected to find and ranges from 1 32 to 1 65 c c per litre at depths between 800 metres and 1,500 metres in the northern part, sinking to less than 1 0 on the bottom in the southern area, but such conditions are of themselves scarcely sufficient to account for the complete absence of life.

The discovery of the second area, in which all life is either completely absent or is extraordinarily scanty, came as a complete surprise I have already referred to the region of the Arabian coast near Ras al Hadd, where we discovered a bottom deposit of soft green mud that smelt strongly of sulphuretted hydrogen, such an area we would expect to find largely, if not entirely, devoid of animal life, but this azoic area appears to extend far beyond the limits of the region where sulphuretted hydrogen is to be found and can be traced throughout the whole extent of the Gulf of Oman In this latter area the bottom consists of either a soft green mud or a grey clay, and between the depths of approximately 300 metres and 1,750 metres there is an almost complete absence of animal life, and even at so great a depth as 3,351 metres an hour's trawl only resulted in the capture of two starfish

In the accompanying tables I have given the various stations and their depths in the Gulf of Oman and off the Arabian coast, and it seems clear that this azoic area not only lies at a deeper general level in the Gulf of Oman than on the Arabian coast but also that there is a difference of level on the two sides of the Gulf of Oman The upper limit of the azoic area on the Arabian coast near Ras al Hadd lies somewhere between 83 metres and 102 metres and the lower limit between 1,253 metres and 1,536 metres The depth of the lower limit, however, probably increases as we pass towards the north-east, where we found prolific life at a depth of 952 metres, the trawl bringing up a number of fish and crustacea and thousands of Ophiuroids, in 1906 the R I M S *Investigator*, when trawling in the near vicinity, also secured a good catch, though the net was badly torn (*vide* Lloyd, 1907, p 2[1]) There can thus be little doubt that this area is a fertile one, but a little to the east at a depth of 1,253 metres we were within the zone of sulphuretted hydrogen and the catch after an hour's haul consisted of a single crab, *Paralomis* sp.

In the Gulf of Oman, the upper limit of the dead area appears to lie at a slightly different level on the two sides. On the southern side in the vicinity of Muscat the great bulk of the fauna disappears between 210 and 269 metres, though a few live animals were obtained at a depth of 610 metres, off the coast of Persian Makran no life was detected at a depth of 448 metres and it is somewhat significant that these levels correspond very fairly closely with the upper level of the deep inflowing mass of water that is running up the Gulf under the out-flowing Persian Gulf water That this water is not *per se* responsible for the absence of life is clearly shown by the results of several horizontal hauls at depths down to as much as 1,500–2,000 metres, for at all depths numerous red deep-sea prawns and small fish, such as *Bregmaceros* sp and Scopelids, were obtained It would appear, therefore, that the sterility of the area must be attributed either to some harmful character of the bottom deposit or else to some seasonal change in the general conditions of the deep water

ARABIAN COAST

Station No	Depth in metres	Character of bottom	Results
53	13	Rock *Lithothamnioneæ*	A good and varied catch
80	16–22	Sand and Shells	A good catch
45	40	*Lithothamnioneæ*, etc	A good and very interesting catch
43	83	? No sample obtained	A small but interesting catch
79	102	Green Mud (H_2S)	Very little animal life
48	201	Rock	A very small catch Net torn
77	350	Green Mud (H_2S)	A single crab, *Paralia alcocki*
56	457	Green Mud (H_2S)	No living organisms, dead shells of *Rostellaria delicatula* and *Encephaloides armstrongi*
57	428–750	Green Mud (H_2S)	Very little life, one dead shell of *Rostellaria delicatula* and a few moribund *Encephaloides armstrongi*
55	802	Stratified green mud	No sign of living organisms
54	952	Green mud and soft rock	A good catch, thousands of Ophiuroids
58	1253	Green mud (H_2S)	A single crab *Paralomis* sp
50	1536–1737	Brown mud	Catch very small
59	1977	Soft Green mud	Catch very small

The surface waters and the inshore areas in both regions, in marked contradistinction, appear to be particularly fertile Along the Arabian coast we have carried out several successful trawls, special attention being paid to areas where the charts indicate the presence of coral, in every case we have found that true reef-forming corals are absent, though we have dredged a number of specimens of *Lophohelia*, *Caryophyllia* and *Flabellum*, some still living though many of them dead The chief ingredient of the reef appears to be *Lithothamnioneæ*

GULF OF OMAN

Station No	Depth in metres	Character of bottom	Results
72	75	Grey clay and shells	A good and varied catch.
71	106	Grey-green mud and sand	A moderate catch
70	109	Soft green mud	Moderately good catch, 213 living examples of *Rostellaria delicatula* and several *Pirula* sp
75	201	Soft green mud	A good catch
67	269	Soft green mud	No living organisms, dead shells of *Rostellaria delicatula* and a few Serpulid tubes
64	448	Grey clay	No signs of living organisms
66	610	Brownish-green mud	Several dead shells of *Rostellaria delicatula* and 3 living examples, a few Serpulids
65	912	Green mud	No living organisms
68	1491–1518	Soft green mud	No living organisms
81	3350	Grey mud	Two starfish

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[1] Schott, G, "Uber die Wasserbewegungen im Bab el Mandeb" *Ann der Hydrographie und maritime Meteorologie*, January 1929

[2] Matthews, D J, "The Percy Sladen Trust Expedition to the Indian Ocean in 1905 No VII Physical Oceanography" *Trans Linn Soc London*, 19, Part 1, 1926

[3] Lloyd, R E, "Contributions to the Fauna of the Arabian Sea, with descriptions of new Fishes and Crustacea" *Rec Ind Mus*, 1, Part 1, Calcutta, 1907

Recent Discoveries at Choukoutien*

By PROF. DAVIDSON BLACK, F R S, Honorary Director, Cenozoic Research Laboratory, Geological Survey of China

UPPER PALÆOLITHIC CULTURE IN "UPPER CAVE" SEDIMENTS

A DETAILED account of the results of the Choukoutien excavations up to May 1933 has already been presented in our memoir "Fossil Man in China" (Mem Geol. Surv. China, Series A, No 11) In that report it was noted that above the *Sinanthropus* deposits there occurred towards the top of the hill a pocket of grey sediments of apparently modern facies, the site being described as the "Upper Cave". During the past season, Mr. W. C. Pei has systematically investigated the deposits of the latter site, ably assisted by Mr. M N. Pien. Their efforts have been rewarded by the discovery of much additional material of unexpected archæological significance

(1) *Sedimentary and lithological characters of Upper Cave deposits.* The "Upper Cave" was a true cave but became completely filled with a mixture of grey cave loam and angular flat limestone fragments, the latter being derived from the collapsed portion of its roof The roof is preserved over a quite large recess of the cave

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* Report of excavations during the field season 1933, presented at the annual meeting of the Geological Society of China on November 11.

which extends to a smaller lower chamber not yet completely excavated. Where exposed, the cave walls are covered with stalactites and stalagmites. The grey Upper Cave sediments are largely unconsolidated and are in contact only over a few square metres with the hard red beds and stalagmitic floors capping the *Sinanthropus* strata of Locality 1. Elsewhere the Upper Cave appears to be developed as an independent system.

(2) *Fauna of the Upper Cave.* Though not very abundant, the Upper Cave fauna is remarkably rich in types and includes a puzzlingly large number of almost complete skeletons, the bones of which lie in correct association and are but slightly fossilised. The most interesting forms are as follows:—*Hyæna* (an extinct species very different from that found in the *Sinanthropus* beds but similar to that of Sjara-osso-Gol), *Felis tigris* (entire skeleton); *Cynailurus*, which is now restricted to India (an entire skeleton), *Viverra* (no longer found in North China), the wild ass, *Equus hemionus*, and the deer, *Cervus elaphus* (an entire skeleton), having antlers curiously similar to the special form from Sjara-osso-Gol.

(3) *Human and cultural remains.* In association with this fauna there occur both human skeletal remains and traces of industry. The skeletal remains are of modern type (*Homo sapiens*) and so far comprise two almost complete but somewhat crushed skulls, other skull fragments and teeth, fragmentary lower jaws, bones of the upper extremity (including one clavicle displaying a healed fracture), vertebræ, leg and foot bones. Traces of fire (charcoal and ash) are abundant.

There are three stone implements in a beautiful black chert, a well-made scratcher in vein quartz and several flakes and nuclei in vein quartz, and also a needle (eye broken), a deer canon bone worked at both ends, some thirty or more fox canine teeth perforated for necklace, an ornamental cylindrical piece made from a long bone of a bird, and a considerable quantity of oolitic hæmatite probably imported from a considerable distance. So far, no trace of pottery, polished stone or microlithic industry has been encountered.

Conclusions. The material recovered will shortly be made the subject of a full report and the conclusions here offered are wholly tentative. (*a*) The Upper Cave deposits appear to be decidedly younger than the *Sinanthropus* layers of Locality 1, from which they are separated by stratigraphic and lithological disconformity and by a faunistic interval (absence of thick-jawed deer, occurrence of a special *Hyæna*, presence of *C. elaphus*, *E. hemionus*, etc.). (*b*) The Upper Cave deposit is, however, probably also Pleistocene in age (collapsed cave, loess-like sediments, presence of Hyæna, cf. *spelæa*, *Cynailurus*, *Viverra*, *E. hemionus*, special deer, etc.). (*c*) In these circumstances, we are inclined provisionally to attribute the associated human remains to a Late Pleistocene, Palæolithic culture. The latter would seem to correspond approximately to the same stage as the Upper Palæolithic of Siberia and Europe. It appears, however, to be somewhat more advanced than the Ordos industries (Shui-tung-ko and Sjara-osso-Gol) in which no typically worked bones have thus far been found in certain association.

Cynocephalus REMAINS

In a cylindrical solution cavity about a metre in diameter in the limestone to the south of Locality 1, Mr. M. N. Pien discovered this season a considerable number of fossil bones imbedded in a peculiar red deposit containing a large proportion of small well-rounded pebbles. These bones are remarkably fossilised and heavy, many of them being water-worn and rounded. A few, however, are well preserved, among the latter being several teeth and limb bones of a large baboon, probably *Cynocephalus wimani*, Schlosser. Strikingly similar deposits containing the same type of heavy rolled bone fossils have already been encountered at the very base of the *Sinanthropus* deposits of Locality 1 (Lower Cave). At the present stage of excavation it remains an open question whether or not these beds represent a pre-Choukoutien stage or merely correspond to an early phase in the last filling of the clefts.

In any case it would seem that one must conclude from this latest discovery that the Choukoutien fissures have been successively inhabited by baboons, by *Sinanthropus* and by a modern type of *Homo*. However, such a coincidence appears less extraordinary when it is recalled that though Ordovician limestone is widely distributed along the Western Hills, at Choukoutien, on account of its low anticlinal structure at the borders of the plain, it is exceptionally well situated for dissection into fissures and caves.

Obituary

PROF. J. JOLY, F.R.S.

JOHN JOLY came of a remarkable lineage. His father's grandfather was a member of a French noble family. His mother, a German countess, whose family had been ennobled by Frederick the Great, was descended from Greek, Italian, and English ancestors. This mixture of blood, perhaps, may explain his ready sympathy with the most diverse personalities, his princely generosity which often gave to others what he denied to himself, and his versatility which enabled him to prosecute research in so many fields of knowledge, and to obtain æsthetic pleasure in the realms of art, literature, music and science.

Joly's earliest papers were mostly occupied with mineralogy. The beauty of the colour and form of minerals had a marvellous attraction for him. In this period he wrote on the ash of Krakatoa, beryl, iolite and harmotome. Investigation on these minerals led him to devise the meldometer and apophorometer, by means of which he determined the melting points of minerals with the greatest accuracy, and was able by volatilisation to reveal their constituents in a much more elegant and delicate way than by the blowpipe. About this time also he devoted some attention to the problem of accurate photometry and devised the well-known diffusion photometer. Next followed the invention of the steam-calorimeter, which not only enabled him to determine with greater accuracy than ever before the specific heats of minerals, but also put into the grasp of his imaginative mind the power of determining directly the specific heats of gases at constant volume In this way he solved an experimental problem which had the highest importance in molecular theory. In 1892, doubtless in recognition of this achievement, he was elected to the Royal Society

By a beautiful novel method Joly obtained the volume change of rocks and minerals on fusion, and so contributed accurate and important data to geophysics His experiments with electrically heated furnaces enabled him at a very early period to isolate aluminium from aluminium silicates, but unfortunately a discouraging word from a senior deterred him from publishing the result, and so others obtained the credit for this method of reducing the element During this period, photographic work became absorbingly interesting to him, and he investigated the relation of the sensitivity of the photographic film to temperature, and suggested the electronic theory of the latent image He invented shutters for use in stellar photography and a photographic method for the detection of variable stars But in this field his most arresting invention was the method of colour photography by which he rendered it possible for the first time to reproduce with accuracy on a single transparent plate the colours of Nature At about the same time, his attention was directed to Lowell's observations on the canals of Mars Contrary to the received statements that these markings on the surface of the planet were all portions of great circles, Joly perceived that this was not the case, and he showed that all could be traced by moons rotating near the surface of the primary, and so propounded a rational physical theory. Another essay of astronomical bearing, startling alike in its imagination and literary style, is his "Theory of the Prematerial Condition of the Universe."

Biological speculations frequently kindled Joly's imagination, and in essays on the bright colours of Alpine plants, and on the abundance of life, he made contributions to biological philosophy which are too often neglected In collaboration with one of the writers of this notice, he formulated the cohesion theory of the ascent of sap, and devised and carried out several novel and beautiful experiments with plants. Here also should be mentioned his speculations on the connexion between cosmic rays and cellular evolution, morbid and normal.

Time and again Joly returned to his first love of mineralogy and geology, and his work on the thermal expansion of the diamond, the action of the ions of sea-water in sedimentation, and the influence of pressure on the order of formation of minerals in igneous rocks, ingeniously made use of physical principles for the solution of long-standing problems. Experiments on solvent denudation led him to formulate his method of determining the geological age of the earth by the sodium content of the ocean The period yielded by this method in its early stages is now generally considered to be an under-estimate, but it must be remembered that, at the time, it materially and rationally extended the much more crippling estimate of the earlier physicists In this connexion may be mentioned the attractive spell the sea exercised on his mind, and while he sailed in small boats or in large ships, geological problems were not the only ones which occupied his thoughts In these surroundings he devised a method of observing the altitude of a celestial object at sea during nighttime, or when the horizon is obscured , he devised the collision predictor and synchronous signalling, an explosive sounder, two types of borers for obtaining samples of sediments and rock from the sea bottom, and floating breakwaters whereby the energy of the breaking waves is transformed into turbulent movements round the keel of a floating vessel

It is, however, in the field of the application of the heat-producing properties of the radioactive elements to geophysical problems that Joly did some of his best-known work So early as 1903, when Pierre Curie and Laborde first definitely established the continuous heat-production of radium, he pointed out the importance of this fact in geological science and its bearing on Lord Kelvin's view of the age of the earth, which was based on thermal considerations The first actual detection of the wide distribution of the radioactive elements in terrestrial surface materials was due to the present Lord Rayleigh in 1906, but afterwards Joly and his pupils devoted much attention to this problem, and measurements on materials from most parts of the globe have been made in his laboratory. In 1909 he devised his method for the measurement of thorium in a rock, a problem previously unattacked, and in 1911 his well-known furnace method of determining the radium content of a rock.

Joly's early views on the effect of radioactivity on earth history are contained in his book, "Radioactivity and Geology" (London. Constable and Co., 1909). His theory of the production of pleochroic halos by α-ray disintegration also dates from about this period. In conjunction with Lord Rutherford he devised a new method of deducing the age of the mineral containing the halo, which gave results for geological ages more in accordance with the other radioactive methods than his previous method based on solvent denudation. In subsequent years he expended much time in further investigation of these halos, obtaining many interesting results, among which may be mentioned his discovery of an unknown radioactive element, which he provisionally named hibernium. During the past year, this element has been shown by G. Hevesy and M. Pahl to be samarium.

Joly's general interest in all radioactive problems, and his great sympathy with human suffering, led to the foundation of the Irish Radium Institute by the Royal Dublin Society in 1914. He was both the originator and strong advocate of this Institute, and its present highly satisfactory condition is largely due to him. Among those to whom Joly was personally known, it would, we think, be unanimously agreed that, of all his many activities, this was the one nearest his heart, and for which he would best like to be remembered. The so-called Dublin method of using radon in fine capillary glass tubes, which can be placed inside hollow metal needles, was first developed by him, and his life-long friend, the late Dr. Walter Stevenson. This method of using radon and not the actual radium salt has always been employed at the Irish Institute, and has also been adopted at many other centres. To the end, his interest in radium therapy never failed; some of his most recent papers, read before the Royal Dublin Society, deal with improvements in its technique. These include the use of native radioactive powders and a mechanical means of focusing γ-rays on deep-seated tumours.

During the War, Joly devoted his attention to various technical problems. At its conclusion, he returned to the study of radioactivity, and was among the first to attempt the separation of the lead isotopes by physical methods. Later he became interested in the problem of vision, and developed a theory of colour vision based on the quantum theory of photoelectric emission and the physiological structure of the retina. In 1923 he was asked to determine the radioactive contents of some South African rocks, and this led him to a reconsideration of the effect of radioactivity in geological history. From this sprang his theory of thermal cycles, which he has so brilliantly presented in his book on the surface history of the earth. The publication of this work is a landmark in the advance of geological science, focusing, as it does, the attention of geologists on the enormous importance of radioactivity in earth history, and giving a rational explanation of the succession of revolutions and geological strata. His subsequent work, mostly carried out in conjunction with one of the present writers, was largely devoted to further radioactive measurements, in the course of which the very low radium content of the eclogites was established, a fact of great interest in geological theory.

John Joly was born in Hollywood, King's County, in 1857. His early education was obtained in Rathmines School. In his school-days, which for various reasons were short, apparently he attracted no special attention in the usual educational tests, but won great popularity among his fellows by his powers of narration and the original tales which he contributed to the school magazine. While at Hyères, where he went for his health, he constituted himself 'foreign correspondent' and published many notes on the natural history of the south of France. Owing to these activities, he acquired among his school-fellows the title of 'the Professor', a title by which he was always known among his oldest friends.

In college Joly was omnivorous in his reading, but always refused to be limited by examination courses, and so it happened that while he studied physics, chemistry, mineralogy and modern literature with zeal, his only academic distinction was first honours in English literature. In the engineering school, however, his soundness and originality were recognised and he was placed at the top of the list in all subjects at the B.A.I. examinations. After his degree he held minor posts in the engineering school and in the school of physics, and while still FitzGerald's assistant, he had already attracted attention by his early inventions and researches in mineralogy and calorimetry. In 1897 he became professor of geology at Trinity College, Dublin, and though he received many offers of more lucrative posts, he remained until his death on December 7 last a Trinity man. Throughout his career, he kept in close contact with the students, and formed and accomplished many schemes for increasing undergraduate amenities. He was keenly interested in the scientific development of T.C.D., and was the originator and secretary of the science fund whereby T.C.D. acquired the present schools of physics and botany, with their equipment and most of their endowment. The special research endowment of the school of geology by the late Earl of Iveagh was a recognition of his personality and distinction as an investigator. He acted for many years as secretary to the Academic Council and was a member of the Board of T.C.D. In 1919 he was elected to a fellowship in the College.

Outside his College also Joly had many activities. He was successively member of council, secretary, vice-president and president of the Royal Dublin Society. He contributed many papers to its *Transactions* and *Proceedings*, and interested himself in every way in its welfare, and in forwarding its aims. He was warden of the Alexandra College and was one of the delegates of the Balfour Educational Mission to America in 1918. On the Board of Irish Lights he was one of the most active commissioners, and delighted to put his scientific knowledge and inventive mind at its service. He was also a governor of two Dublin hospitals. In his earlier days he was a keen Alpine climber, and yachtsman, and many of his researches were planned and his philosophical and speculative writings discussed with his companions on these expeditions. His fundamental method of treatment, his extraordinary originality and intellectual fertility, and his æsthetic appreciation of Nature made these conversations unforgettable by those who had the good fortune to be with him.

HENRY H. DIXON.
J. H. J. POOLE.

Mr. H. F. Biggs

We regret to record the death at Oxford on January 9 after a short illness of Mr. Henry Francis Biggs, whose place in the University as a tutor in physics will be difficult to fill. In spite of severe calls on his time and energy in the fulfilment of his academic work, he took a keen interest in the latest developments of physics, and contributed to the columns of this journal and to other scientific journals. His main published works are an "Introductory Sketch on Wave Mechanics" and a monograph on "The Electromagnetic Field", the latter of which appeared only a few days before his death.

Mr. Biggs went to Oxford in 1919 as a demonstrator in the Electrical Laboratory under Prof. J. S. E. Townsend, and took an active part in the teaching of physics in the University. He had a varied experience of academic life, having studied at Trinity College, Dublin, and at Cambridge, and having held a lectureship at the South African College (now the University of Cape Town), and later a lectureship at the University of Manchester. During the War he was attached to a sound ranging unit, where his theoretical knowledge, his practical skill and inventive ability found abundant scope.

Mr. Biggs will be greatly missed by his pupils and colleagues, who will long cherish the memory of a cultured, courteous and interesting personality.

We regret to announce the following deaths:

Sir William Lawrence, treasurer of the Royal Horticultural Society, 1924-29, formerly lecturer in organic chemistry in the University of Manchester, on January 4, aged sixty-three years.

Sir Donald MacAlister, K.C.B., Chancellor of the University of Glasgow since 1929, and president of the General Medical Council in 1904-31, on January 15, aged seventy-nine years.

News and Views

Dr. Harlow Shapley

The Gold Medal of the Royal Astronomical Society has been awarded to Dr. Harlow Shapley for his studies of the structure and dimensions of the galactic system. Dr. Shapley, who was born on November 2, 1885, has been director of Harvard College Observatory and Paine professor of astronomy at Harvard since 1921, succeeding E. C. Pickering. He is known particularly for his development of the period-luminosity law of the relation between the period of variation and the absolute magnitude of Cepheid variable stars. The apparent magnitude of the Cepheid variables in a globular cluster is measured and compared with the known absolute magnitude of a Cepheid of the same period, and from this the distance of the cluster is obtained immediately, provided absorption of light in interstellar space is negligible. In 1915-18 he published a noteworthy series of papers on researches on the globular clusters which brought these objects prominently before astronomers. His principal results were brought together in 1930 in his "Star Clusters". Dr. Shapley's investigations have been applied at Mount Wilson by Dr. E. P. Hubble to measure the distances of the spiral nebulæ. Recent papers from the Harvard College Observatory have discussed the distribution of the galaxies and the uniformity of distribution of matter in space. Dr. Shapley is a member of the United States National Academy of Sciences and an associate of the Royal Astronomical Society.

Colwyn Gold Medal of the Institution of the Rubber Industry

The Colwyn Gold Medal of the Institution of the Rubber Industry has been awarded to Dr. O. de Vries, until 1930, director of the Rubber Station, Buitenzorg, for scientific work in connexion with the production of raw rubber. The medal was presented to Dr. de Vries by Sir George Beharrell, president of the Institution, on the occasion of the twelfth annual general meeting of the Institution held on January 12. Dr. O. de Vries has devoted the best part of two decades to the investigation of plantation rubber problems. His work at the Buitenzorg Testing Station in Java brought world wide fame not only to the Testing Station but also to himself. It covered a large number of problems of various types which arise between the growing of the tree and the eventual vulcanisation of the rubber in the distant factories. He cleared up many obscure plantation practices, indicating the reason, if any, for their existence. Dr. de Vries overhauled and set new standards in methods for testing plantation rubber. His investigations contributed to the further standardisation of plantation rubber and its characteristics in respect to vulcanisation and mechanical qualities. The principal aspect of Dr. de Vries's work has been his desire to ensure its availability throughout the world. The result of his investigations were published in Dutch, but with a generous disregard for the labour entailed, the publication of each investigation was accompanied by a version in English. Similarly in 1920 he produced an English translation of his well-known book on "Estate Rubber", the original Dutch version of which appeared in the following year. This book is a lasting monument to his activities.

Early Man in China

Further exploration at Choukoutien has resulted in discoveries which, if less sensational than that of Peking man, are none the less of considerable importance as additions to our knowledge of the distribution of palæolithic industries and of 'modern man' in late pleistocene times. According to Prof. Davidson Black's report on field-work at Choukoutien in 1933, which was presented at the annual meeting of the Geological Society of China on November 11, and appears in this issue of NATURE (p. 89), Dr. W. C.

Pei and Mr. M. N. Pien, in excavating the grey sedimentary deposits of what is known as the "Upper Cave", have discovered human skeletal remains in association with a fauna, in part extinct, implements of stone and bone and abundant traces of fire and charcoal. These sedimentary deposits were largely unconsolidated and in contact only over a few square metres with the hard red beds and stalagmite floor capping the strata in which the relics of *Sinanthropus* were discovered. The human skeletal remains include two skulls, which fortunately are complete, though said to be "somewhat crushed", so that there should be no question of the correctness of their attribution to *Homo sapiens*. Full description of their specific characters will be awaited with the greatest of interest, as the first specimens of 'modern man' of palæolithic age to be found in China. In view of the character and associations of the discovery, subsequent consideration should confirm rather than controvert Prof. Black's tentative conclusion as to the late pleistocene dating of the find and the correspondence of the industry with the Upper Palæolithic of Siberia and Europe. The further discovery of fossilised bones of baboon, upon which Prof. Black bases a sequence of baboon-*Sinanthropus-Homo sapiens*, points to conditions at Choukoutien which will repay exhaustive study of the site.

Indian Earthquake of January 15

AN earthquake of considerable strength and of much interest occurred in Northern India at about 2.40 p.m. on January 15. The loss of life was larger than at first appeared, 61 deaths being officially reported in the Patna district, 1,000 unofficially reported at Muzaffarhur, and smaller numbers in other districts. In its long duration and immense disturbed area, the earthquake possesses two features of a great destructive shock. An interesting point in the recent earthquake is its probable connexion with the great earthquake of June 12, 1897, described by Mr. R. D. Oldham in a report which is one of the most valuable that we possess on any earthquake. The places that suffered serious damage are (from east to west) Jamalpur, Darjeeling, Patna, Gaya (Bihar), Benares and Cawnpore. Jamalpur lies within the epicentral area of 1897. All the others are included within an area about 600 miles long from east to west. The epicentre thus seems to lie about 350 miles to the west of that of 1897. At Calcutta, about 300 miles south-east of the epicentre, the shock was so strong that the seismograph at Alipore was put out of action. The shock there is said to have lasted 8 min., the violent motion in the middle continuing for 1½ min. Durations of 5 min. at Cawnpore and 3 min. at Delhi are also reported, but strong after-shocks may be included in such estimates. At Jubbulpore (about 350 miles from the epicentre) houses were shaken so strongly that people hurried into the streets. Even at Bombay (more than 800 miles), a mild shock was felt.

THE area disturbed by the earthquake may thus amount to as much as two million square miles, or about the same as that over which the Assam earthquake of 1897 and the Kangra earthquake of 1905 were felt. The whole Himalayan arc is bounded by four great seismic regions, namely (from east to west), Assam, Nepal, the Punjab and Cashmere. Denoting these regions by the letters *A*, *B*, *C*, *D*, and confining ourselves (with one exception) to great destructive shocks, we have the following succession of areas disturbed: *D* 1828, *C* 1832, *B* 1833, *A* 1869, *B* 1869, *C* 1875 (semi-destructive), *D* 1885, *A* 1897, *C* 1905, *B* 1934, a continuous migration from *D* to *A* and back again to *D*, followed by an oscillation to the east in 1897, back to the north-west in 1905, and ending in the intermediate region in the present year.

Wave-length Changes of European Broadcasting Stations

ABOUT an hour before midnight last Sunday, January 14, a large proportion of the broadcasting stations in Europe adjusted their wave-lengths to conform with the provisions of a scheme evolved at a conference of the International Broadcasting Union held at Lucerne in May and June 1933. The object of this Lucerne Plan was to effect such a distribution of wave-lengths from a geographical point of view that the amount of interference caused to the service of any broadcasting station should be reduced to a minimum. To assist in the matter, the Plan also provides for certain maximum power limitations which differ according to the wave-length range. Unfortunately, the operation of the scheme at the present time is not completely successful because several countries declined to sign the agreement, while a few individual stations are also not abiding by the terms applicable to their country. During the first portion of the change-over programme, each broadcasting station adjusted its wave-length with the aid of its own national calibrating station. Then at about 2.30 a.m. on Monday morning the Brussels Checking Station of the International Broadcasting Union began to check the wave-lengths of the stations at the rate of twenty-four an hour, this procedure continuing until about 7.30 a.m. This checking process was resumed during Monday night after the cessation of the normal programmes.

ON the medium wave-lengths band, the changes were carried out without much difficulty and when the final adjustments have been made at certain stations, it is expected that European reception of broadcasting in general will have been appreciably improved. On the long-wave band, however, certain difficulties have resulted from the non-compliance of some countries and stations with the provisions of the scheme, but it is hoped that a convenient compromise will be reached in the near future. Listeners to British stations will not experience much difficulty in finding their new tuning adjustments, for except in the case of Bournemouth, the change was fairly small. A useful pamphlet, entitled "The Lucerne Plan", explaining the wave-length changes has been published by the B.B.C., and some of technical periodicals such as the *Wireless World* and *World Radio* have provided useful charts by means of which the new position of any European station on the wave-length scale can be ascertained.

New Chemistry Building at University of Leeds

SIR FREDERICK GOWLAND HOPKINS, president of the Royal Society, formally opened the new chemistry building at the University of Leeds, on January 12, in the presence of the Pro-Chancellor of the University, Col C. H. Tetley, the Vice-Chancellor, Sir James Baillie, and a representative gathering of past and present members of the University and of visitors from other universities. Sir Frederick Hopkins, in an address entitled "Modes of Thought in Chemistry", stressed the importance of chemical knowledge for national progress and emphasised the importance of experimental inquiry in pure chemistry, one of the fundamental sciences. In a critical and stimulating discussion of the differences in the habits of thought of workers in the several sections of pure chemistry, he dwelt on the great results which have been achieved especially in organic chemistry by the use of a mode of thought essentially pictorial and non-mathematical, which is as necessary as the more quantitative methods of the physical chemist. After the ceremony in the large lecture theatre, an inspection was made of the new laboratories The rapid growth of the Department under Prof Arthur Smithells, who succeeded Sir Edward Thorpe and by whose efforts the chairs of organic and physical chemistry were instituted, called for an extension of space but for many years the only quarters available were buildings of a temporary nature and geographically separated. Now, thanks to the generous response of the public and the policy of the University Council, all the various sections of pure chemistry have been gathered together under one roof in a new building facing Woodhouse Lane, which forms the latest addition to the general scheme for the extension of the University of Leeds

Ball Lightning

PROF. J C. JENSEN, of Nebraska Wesleyan University, Washington, describes in *Physics*, vol. 4, October, 1933, how he was fortunate enough to photograph ball lightning when he was taking photographs of ordinary lightning in an August thunderstorm. The display of lightning was taking place in the region of the outrushing cold squall in advance of the main mass of the storm, and this squall was carrying with it great quantities of dust. In the wake of one of the flashes came the globular lightning, apparently floating slowly downwards. Two or three brilliant globular structures of the kind known as ball lightning appeared to travel along a pair of high-voltage power lines for a considerable distance, eventually falling to the ground and disappearing with a loud report. Two are clearly visible on one of the photographs, and, as their distance was known, it was an easy matter to determine their diameters, which were found to be very much larger than numerous observations of the phenomenon made elsewhere would have led one to expect, namely, 28 ft. and 42 ft. Unfortunately, ball lightning is so rare compared with ordinary lightning that the much desired confirmatory evidence of the occurrence of such large globular structures that might result from further photographs may be a long time in coming There seems no doubt from the repeated observations of ball lightning made inside houses, and from the size of holes made by it through window-panes, that it is generally much smaller.

Mind, Brain and Survival

DR WILLIAM BROWN, lecturing on "Modern Science and the Possibility of Survival", at the Survival League at Caxton Hall on January 11, discussed the various theories of relation of mind to brain, and expressed the view that nothing firmly established in modern science makes personal survival after bodily death intellectually inconceivable But the task of obtaining reliable evidence is beset with enormous difficulties The results and messages in mediumistic trance should be closely scrutinised in the light of modern knowledge of the psychology of the unconscious, and sifted with due regard to the statistical laws of chance coincidence Spontaneous psychic experiences on the part of private individuals, though more reliable in other respects, are specially difficult to assess statistically There is little doubt that a large proportion of the apparent evidence for survival has to be rejected by strict science ; but when all the sifting has been done there remains a small residuum very difficult to explain Phenomena can only be fitted into a scientific system if their conditions of causation are known, and this is far from being the case with psychic phenomena, although some of the more general conditions are being gradually revealed. Very thoroughgoing psychological analysis of selected mediums will advance our knowledge considerably in this dim borderland of science, and may indicate further lines of investigation.

Administration and Management in Industry

THE number of societies and institutions dealing with the administrative or managerial side of industry is now very considerable and covers a wide and varied field in works management, costing, salesmanship, advertising, research, etc. That there is plenty of work and scope for organisations of this sort is evident enough, but there is certainly some ground for supposing that their number may soon become excessive, and some at least may be unable to obtain sufficient financial support to keep going, especially since the subscription rates are necessarily rather high and correspondingly onerous to manufacturers and their executives in these difficult times. From its name, the Institute of Industrial Administration should be capable of covering the whole territory, but it has many rivals It is to be hoped there is room for all, and that there will be no desperate struggle for survival The Institute held its annual general meeting on December 12, and an increase in the subscription of corporate members from 3 guineas to 5 guineas was recommended. This is to be interpreted, we hope, as a measure of increased usefulness to members rather than as an expiring clutch for more funds. The papers presented at the 1932–33 session have just been published, on

'Roneod' sheets bound in paper covers (London: Institute of Industrial Administration, 1933. 5s.). They are none the worse for this, and two of them deal in an effective manner with difficult problems of distribution, and another is on research in industry, by Mr. A. P. M. Fleming.

In few branches of social study, however, is there a greater tendency to discursiveness and mere talk than in these various divisions of industrial administration, especially in salesmanship and advertising; and in fewer still is there a greater misuse of the term 'science'. In the papers here published it must be admitted that this tendency is little in evidence. They are indeed bright, brief and stimulating. The discursive tendency is perhaps exhibited most in the first paper on personal and impersonal management, by H. N. Munro, although his theme, so far as it can be definitely apprehended, seems sound enough. The next two papers, on distribution, are well worth reading and serious reflection, not only because this subject is one of the most important and difficult in the present age, but also because the authors strongly condemn that 'production complex' which is still too much in evidence in industrial management. One of them, based largely on personal experience, has an air of convincing reality and logic which is very attractive. It is scarcely necessary to say that Mr. Fleming's paper on research is characterised by his usual methodical and orderly presentation, and overwhelming arguments in support of far-sighted research policies and carefully thought-out research programmes. Other papers deal with finance and secretarial duties.

Flood and Erosion Control

Among the various expedients put forward for dealing with the problem of unemployment in the United States, one of considerable interest from a scientific point of view is that of Dr. L. E. Freudenthal, chairman of the Institute of Irrigation Agriculture, American Farm Bureau Federation, Las Cruces, N.M. In an address to the South-Western Division of the American Association for the Advancement of Science, which appears in *Science* of November 17, 1933, he points out that flood and erosion control are matters of national importance in America in that they are beyond the capacities of individual States to deal with. He instances the huge sums of money which have been beneficially expended on water supply, irrigation, water power and waterway undertakings and the equally enormous losses of life and property due to floods and erosion. The Mississippi flood of 1927, which inundated 18,000 square miles, drove 750,000 persons from their homes, did some 300,000,000 dollars worth of damage and took 246 lives, is, he states, an example of what is happening annually on a smaller scale in nearly every State. For the last twenty years, flood damage in South Carolina and Tennessee has averaged nearly one million dollars per annum.

The attendant erosion of fertile lands is stated by Dr. Freudenthal to be a national menace and he quotes a report of the U.S. Bureau of Soils to the effect that not less than 126 billion pounds of plant food material is removed from the fields and pastures of the United States every year, the value of the plant food elements in the waste being 2½ billion dollars annually. Erosion, adds Dr. Freudenthal, has been the principal cause for abandoning millions of acres of cleared land, and he goes on to suggest various directions in which Government assistance might be rendered in the matter of flood control measures with the object of providing relief for unemployment, including stream regulation, tree and brush planting, contour furrowing, protective fencing and seeding. He believes that flood and erosion control work are ideally suited for unemployment relief, not only for the reasonably effective results which could be obtained, but also because of the possible excellent effect upon the unemployed themselves.

Darwin's Parish

Sir Buckston Browne's generous gift to the British Association, in trust as a national possession, of Down House, Charles Darwin's home for forty years, and his further benefaction of the Research Farm of the Royal College of Surgeons at Downe, have revived the association with science of a secluded Kentish village which has retained much of its rural character, although within twelve miles of Charing Cross. It is sometimes forgotten that Downe was the residence of the Lubbocks and that it was here that John Lubbock, afterwards the first Lord Avebury, entered into the close and lifelong friendship with Darwin which exercised so great an influence on his scientific work. It is only reasonable to expect that those who visit Down House, now that it has become a place of scientific pilgrimage, should wish to know more of the history of its village. This need has been met in a little book ("A History of Darwin's Parish: Downe, Kent", Russell and Co., Southern Counties Ltd., Southampton, pp. viii + 88. 1s. 6d.) written by Dr. O. J. R. Howarth, secretary of the British Association, and Mrs. Howarth, with a foreword by Sir Arthur Keith, now also a resident of Downe. The parish history has nothing sensational to relate; but apart from the association with Darwin, it is interesting as a record of the life of a typical secluded English village—a life, which as the authors allow us to see by their skilful selection from humdrum records, was not without its humours and its tragedies. The evidence, which, so far as written documents are concerned, begins about A.D. 1100, is fragmentary at the best; but the authors have made the most of their material and have produced a really informative and interesting account of the parish.

Psychology in Germany

The German Psychological Association's proceedings at its thirteenth congress, held at Leipzig on October 15–19, are reviewed in a thoughtful article, "Psychology under Hitler" by Goodwin Watson of Columbia University, in *School and Society* of

December 2. In that assembly of more than six hundred, Jewish members of the Association, among whom are many who have been leaders of psychological thought, were conspicuous by their absence—and an opening address emphasised the demand for a psychology which expresses the genuine German spirit. *Gestalt* concepts were much in evidence and underlying all discussion was the assumption that parts are influenced by their membership character in larger wholes. It seems clear that "German psychology is developing a special concern for the type of *Gestalt* which is not limited to the perceptual field, but gives us the essential way of life of a whole personality". Of great practical significance was the address of Poppelreuter on political psychology. This directs attention to an increasing preoccupation with character and life as against intellect and theories and to the change of attitude brought about by the Hitler revolution, a change from an attitude of helplessness to one of determination to create, from disunity in economic ideas, political programmes, morality and world views to a sense of a common purpose. In the new whole of German culture, psychology no less than the other sciences must contribute to the realisation of the common purpose. "American psychologists," says Dr. Watson, "surveying the scene as spectators, may well wonder how long they can retain their own very considerable isolation from the major tasks of our generation." Coming as it does from the most influential focus of psychological doctrine in the United States, the comment is not without a certain piquancy.

History of the Parsons Steam Turbine

THE first issues for 1934 of the *Engineer* contain two instalments of a series of articles to be devoted to the development of the Parsons steam turbine. It is just fifty years since Sir Charles Parsons took out his patents for improvements in electric generators and improvements in rotary motors actuated by elastic fluid pressure, and constructed his first turbo-generator. This machine developed about 7·5 kw. To-day single turbo-generators of 100,000 kw. capacity are in use, and the present estimated value of Parsons turbines alone is £152,000,000, the figures for marine and land turbines being £92,000,000 and £60,000,000 respectively. Nothing to equal that rapid extension of value and dimensions has ever happened before. The publication of the series of articles will take many weeks and will appropriately mark the jubilee of this great invention. The first article contains a detailed description of the original turbo-generator, while the second, after referring to the early development of the parallel-flow turbines, deals with the radial-flow turbines of 1889–91.

Automatic Voltage Control of Electrical Systems

THE problems which arise in connexion with maintaining the voltage of supply constant in electrical distributing systems have been closely studied by electrical engineers during recent years. The permissible variation allowed by the regulations is plus or minus four per cent of the 'declared' voltage, but the average regulation is much closer; the houses near the supply station at times of maximum load are supplied at a voltage above the declared pressure and the few near the ends of the distributing mains at a voltage below the normal. The lamps near the supply station therefore give a better light and have a shorter life than the distant lamps. In a paper read by W. Kidd and J. L. Carr to the Institution of Electrical Engineers on December 7, methods of automatic voltage regulation and switch control were described. The city of Manchester is the first area to have complete automatic voltage regulation and it also has supervisory control for its main sub-stations. By a careful application of automatically controlled regulators it is shown that the voltage on distribution networks can easily be maintained within the permissible limits. Manual control of voltage is never quite satisfactory and necessitates the uneconomic employment of additional labour. The installation of the regulating equipment gives better service to the public and removes a possible cause of complaint. It has to be remembered that a rise or fall in the voltage of one per cent increases or diminishes the light emitted by the lamp by about three per cent. Several diagrams are given showing methods of adapting existing transformers by means of automatically controlled tap-changing devices so that the voltage of supply can be kept constant at all loads.

Organisation of a Social Centre

IN a recently issued publication entitled "The Centre" (London: P. S. King and Son, Ltd. 3*d*.) various problems confronting the organisers of social centres for the unemployed are discussed by five contributors, who have had experience in the running of such centres. Special emphasis is laid on the importance of not losing sight of the individual in the mass, and of adapting the facilities provided to the needs of the individual. To prevent employables from becoming unemployable, though most desirable, is but a small part of a centre's activity. The way social centres can help best is to aid the individual to discover new powers, since this is the key to re-creation and progress. One person may need opportunities for thinking (study, reading, talks or discussions); another may wish to make something; another may prefer some form of amusement (a game, dancing, gymnastics); others again may want advice as to cooking food, mending boots, making clothes or keeping well. It is no part of the purpose of a centre to compete with or undercut existing employment. It is conceivable that certain articles such as handwoven scarves might find a ready market, but the repeated manufacture of products of the same kind is not the aim of a social centre. The work there should be undertaken for the sake of the effect which the making has upon the maker. Its purpose is to perfect the individuals and this will not be obtained by encouraging them to do the same thing over and over again.

Non-Reflecting Windows

In connexion with the note under this title in Nature of January 13, p 59, a correspondent points out that the principle can be applied to the glazing of pictures and of museum cases, both of which applications were explained and discussed, with illustrations, in the *Museums Journal* of November 1932 (pp 305–308).

The Zoological Station, Naples

The attention of British zoologists, botanists and physiologists is directed to the facilities for research available in the Zoological Station, Naples A Committee of Section D (Zoology) of the British Association is empowered to nominate competent research workers to a table in the Naples Station which has been maintained by the British Association since 1876 Workers so nominated are provided, without charge, with material and ordinary chemicals and apparatus The Station possesses a considerable range of apparatus for physiological and biochemical investigations Applications for the use of the table should be sent to the Chairman and Secretary of the Committee, Prof J H Ashworth, Department of Zoology, The University, Edinburgh, and should specify the nature of the research proposed and the period for which the table is desired

Geological Society Awards

The following awards of the Geological Society of London have been made for this year The Wollaston medal to Sir Henry Miers, honorary professor of crystallography in the University of Manchester, for his researches on the mineral structure of the earth, and especially in the realms of crystallography and mineralogy, the Murchison medal to Prof George Hickling, professor of geology in Armstrong College, Newcastle on-Tyne, for his contributions to geological science in many branches, but especially in the stratigraphy of the Coal Measures and the structure of coal, a Lyell medal to Dr Finlay Lorimer Kitchin, of H M Geological Survey, in recognition of the value of his contributions to palæontological science, another Lyell medal to Prof Walter Howchin, emeritus professor of geology and palæontology in the University of Adelaide, South Australia, for his geological and palæontological researches in Australia and particularly for his investigations of ancient glacial deposits, Wollaston fund to Dr. William Richard Jones, of the Royal School of Mines, in recognition of the value of his work in economic geology and his recent investigations in silicosis, Murchison fund to Dr Wilfrid Jackson, assistant keeper in the Manchester Museum, for his contributions to Pleistocene geology and palæontology and to malacology, Lyell fund to Mr. Frederick William Shotton, in recognition of the value of his work on the Upper Palæozoic and Quaternary rocks of the Midlands

Announcements

Dr W Cawood has been appointed to a Moseley research studentship of the Royal Society, for work on the accurate determination of molecular weights of gases.

Upon the retirement from the public service of Dame Janet Campbell, as from December 31 and of Sir George Buchanan, as from February 18, Dr. Jane H. Turnbull will be in charge of the Maternity and Child Welfare Division of the Medical Staff of the Ministry of Health and Dr J M. Hamill will act as senior medical officer in charge of the Foods Division of the Ministry.

At the annual general meeting of the British Ecological Society held at Cambridge on January 2–4, the following officers were elected. *President*, Prof. J R Matthews; *Vice-President*, C. Oldham; Hon. Editor of the *Journal of Ecology*, Prof. A. G. Tansley; Hon. Editor of the *Journal of Animal Ecology*, C S. Elton; Hon. Secretary, Dr H. Godwin. The Council unanimously approved the nomination of Prof H. C. Cowles and Prof. L. Cockayne for honorary life membership of the Society

The twentieth International Congress on Alcoholism will be held at the Imperial Institute, South Kensington on July 30–August 3 under the presidency of Lord Astor The aim of the Congress is to secure a comprehensive world picture of the present position concerning alcoholism in its various ramifications in social life. The mornings will be devoted to the consideration of national surveys, and the afternoons to papers on education, the influence of legislation on the consumption of alcoholic beverages, alcohol in the treatment of disease, the causes and treatment of inebriety, alcohol and eugenics, alcohol and heredity and the organisation of press work All communications concerning the Congress should be made to the convener, Dr C C. Weeks, 33 Bedford Place, W C 2.

Applications are invited for the following appointments, on or before the dates mentioned —Examiners for the Aeronautical Inspection Directorate of the Air Ministry—The Secretary (S.2), Air Ministry, Adastral House, Kingsway, London, W C 2 (Jan. 26). A lecturer in pharmaceutical chemistry in the Department of Pharmacy in the Birmingham Central College—The Principal, Central Technical College, Suffolk Street, Birmingham, 1 (Jan. 31). An assistant chemist in the Royal Naval Cordite Factory, Holton Heath, Dorset—The Secretary to the Admiralty (C.E. Branch) (Feb. 3). A chief veterinary inspector for the Leicestershire County Council—The Clerk of the County Council, 10 New Street, Leicester (Feb. 3). A public analyst for the Metropolitan Borough of Fulham—The Town Clerk, Fulham, London, S.W.6 (Feb 7). A teacher of domestic science at the National Training College of Domestic Subjects, 72, Buckingham Palace Road, London, S W.1. A veterinary officer for the County Borough of Wallasey—The Town Clerk, Town Hall, Wallasey.

Erratum In the table on p 3 of Nature of January 6, the heading of the third column should be "Manual workers per 100 acres" and not "Manual workers per acre".

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

A Suggested Explanation of β-Ray Activity

IN continuation of our letter on the above subject which was published in NATURE of November 11, 1933, p. 747, we wish to add the following remarks:—

We have changed the term 'electrodivision of quantum' used in that letter to 'electrofission of quantum'. Under the intense electrical field of the nucleus, a quantum of sufficient energy undergoes *fission* into an electron and a positron, the energy being distributed between them in varying proportions, but the law of conservation of energy continues to hold good.

Our interpretation offers an unforced solution of Bohr's paradox that though the nucleus contains no electrons, free or bound, but only positive particles (α-rays, protons) and neutrons—a view which is now universally held—a β-ray can be created inside it and ejected with high speeds. It has further been established that radioactivity, whether marked by an α-ray or a β-ray disintegration, is mainly due to the leakage of loosely bound α-particles through the potential barrier. The β-ray is only a by-product, when the α-particle cannot escape, but on leaking to the second crater falls into a lower level, and gives rise to a γ-ray which undergoes fission into an electron and a positron.

We should further add that the phenomenon of 'electrofission' is different from the reverse process of annihilation of charges or conversion of radiant energy into mass postulated by many astrophysicists. For when a positron and an electron combine to form one or two γ-ray quanta, the charges do not neutralise but form a dipole which can be again disrupted into its constituents. This does not bring us nearer to the problem of the total conversion of mass to radiation, for the main amount of mass resides in the neutron, which according to one of us (Kothari) is a dipole formed of two Dirac magnetic poles of opposite sign, separated by a distance of e^2/Mc^2. The neutron evidently cannot be disrupted by the nucleus; the binding is too strong. It may be disrupted, however, by the electromagnetic action of cosmic rays, giving rise to free magnetic poles. Such phenomena, to our knowledge, have not yet been observed.

Much other evidence, physical as well as astrophysical, in favour of these views has been obtained.

M. N. SAHA.
D. S. KOTHARI.

Allahabad,
Dec. 5.

Activities of Life and the Second Law of Thermodynamics

IN "The New Background of Science" Sir James Jeans, in discussing the activities of life in relation to the second law of thermodynamics, states that living organisms must possess some method of evading this law. He points out, for example, that a visitor to this planet from some other universe would observe various curious and highly improbable arrangements of matter, such as collections of gold in various places, numerous collections of ice in hot climates, etc. These improbable arrangements or organisations imply presumably a decrease of entropy, that is, a violation of the second law. Surely, however, these actions are functionally inter-related with other simultaneous actions; namely, the metabolism and oxidation of food by the human organisms and the oxidation of fuel in such engines as they employ, and these causally inter-related actions involve an increase of randomness, that is, disorganisation and consequent increase of entropy. I presume that Sir James Jeans would agree that the total effect will be a net increase of entropy.

An essential feature of the second law is that a finite amount of organisation may be purchased at the expense of a greater amount of disorganisation in a series of inter-related spontaneous actions. If for a single moment the blood sugar circulating through the brains of Sir James Jeans's humans should cease to be oxidised, they would fall down unconscious and cease to be able to collect gold or ice. Is it good logic to pick out a series of actions which imply an increase of organisation and therefore a decrease of entropy, whilst neglecting simultaneous interlocked actions in the same system which involve a greater increase of entropy, and then to announce as a mysterious result that the former actions evade the second law? Could one not reason in a similar manner that a crystal evades the second law when we watch a crystal growing in a supersaturated solution? No doubt the growth of the crystal involves *per se* an increase of organisation, but this increase is purchased at the expense of a greater decrease of organisation in the inter-related actions, as may very readily be demonstrated. Such examples in inorganic Nature can be multiplied almost *ad infinitum*.

I do not wish to assume the rôle of a die-hard *fidei defensor* of the science of the nineteenth century, or to assert or even suggest that the present known principles of science suffice to offer an adequate description of the phenomena of life. Indeed, in various publications I have striven to show that such an opinion or assertion would be quite unjustified. Nevertheless, I would humbly suggest that eminent physicists must not ignore the known and relevant facts of biochemistry, and that a knowledge of these facts may serve to remove a certain amount of mystery from their minds.

F. G. DONNAN.

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Artificial Production of the Blue Fluorescence of Fluorite

CATHODO-LUMINESCENCE, thermo luminescence and phosphorescence of fluorite show the well-known rare earth lines. These are, as a rule, not conspicuous in the *fluorescence* excited by filtered ultra-violet light, except in certain cases, especially when the concentration of the rare earths is high, as in yttrofluorite and yttrocerite, but also in some ordinary fluorites, especially after suitable heat treatment.

Generally the fluorescence shows only three diffuse bands in the red, green and blue-violet, differing also in their behaviour towards temperature. As has been shown previously[1], the capacity to emit these bands, the well-known blue one included, can be destroyed by heating and regenerated by treatment with radium rays (radio-photofluorescence).

Systematic experiments with synthetic materials, kindly prepared for us by Miss E. Rona, have proved that the element responsible for the blue band is a rare earth, most probably europium Pure CaF_2, and CaF_2 with additions of one per mille Ce, Pr, Nd or Sm, do not show, after heating and exposure to radium rays, the blue band when examined visually with ultra-violet light; CaF_2 with Sm containing traces of Eu show it distinctly, with pure Eu very strongly, with Gd weaker, with Tb, Dy, or Ho not perceptibly With one per mille Eu and suitable heat treatment, we obtained preparations that fluoresce, after radium treatment, with purple light; prolonged ultra-violet illumination destroys the red band and the preparation then emits a beautiful blue light, which, in intensity and colour, exactly matches the fluorescence of the best English fluorites Spectrograms of the fluorescence of such a natural fluorite (Weardale) show, after sufficiently long exposure, amongst other lines, several coinciding with europium lines Also when the preparations are diluted to one-tenth per mille the one containing Eu gives the greatest intensity of the blue band

A more detailed report will be presented to the Vienna Academy of Sciences in due course, when the influence of the other rare earths and of their concentration have been examined

H HABERLANDT
BERTA KARLIK
K PRZIBRAM

Institut fur Radiumforschung.
Vienna
Dec 9

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[1] H Haberlandt and K Przibram, *Mitt Inst Rad -Forsch*, No 313, *Wien Ber*, IIa, 142, 235, 1933

Interpretation of the Benedicks Effect

ACCORDING to Benedicks[1], thermoelectric forces should exist even in a homogeneous substance, if only the gradient of temperature is asymmetrically distributed. For example, a potential difference should occur at the ends of a homogeneous wire when both are kept at the same temperature, if a point in between is heated in such a way that the decrease of temperature takes place in a much shorter interval at one side compared with the other The ordinary theory of conduction leads to effects which depend on the total temperature difference only and not on the length of the interval. Considerable doubt[2] has been expressed, therefore, as to the reality of this Benedicks effect. By quite a simple macroscopic consideration, however, its existence can be demonstrated and also its maximum magnitude in a limiting case can be derived

The conditions for the Benedicks effect must be such that the assumptions of the ordinary theory of conductivity cease to be valid The only possibility for this, so far as I can see, consists in gradients of temperature so high that a considerable variation of temperature (compared with temperature itself) occurs in an interval short compared with the mean free path *l* of the electrons

A general theory for this case seems to be extremely difficult, but one may hope for simplification in the limiting case of a sharp jump of temperature (with a breadth small compared with *l*). Even this offers still a rather complicated problem, as the distribution function for the electrons near the discontinuity is influenced by the neighbourhood of the material with a different temperature and is not simply the distribution calculated in the ordinary way for a homogeneous material. (In the case of a contact of two different materials at the same temperature, it can be easily shown that the distribution is not disturbed, the ordinary theory remaining valid therefore) It is only if the 'back diffusion' of the electrons returning from the other side of the discontinuity can be neglected, that conditions become more simple, as the distribution remains the ordinary one up to the contact itself.

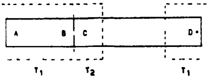

FIG 1

This can be arrived at in two ways. Either the dimensions of the contact are to be small compared with *l* (so that we have, say, a hole, as in the Knudsen effect), or an intermediate layer (for example, a potential barrier of some sort) is present, which reflects the greater part of the impinging electrons, transmitting a small fraction only Such a hole conforms to a degree to the usual experimental conditions, as the cross-section of the contact is kept as small as possible to obtain a high gradient of temperature.

Consider, therefore, a 'Benedicks chain' as in Fig. 1, with a sharp jump of temperature and a suitable contact (hole or barrier) between the points *B* and *C*. The potential difference φ_B between the points *A* and *D* (kept at the same temperature, T_1) consists then of two parts:

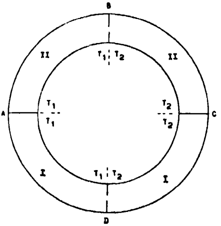

FIG 2

$$\varphi_B = \varphi_D \Big|_{T_2}^{T_1} + \varphi_T \Big|_{T_1}^{T_2} = (\varphi_D - \varphi_T) \Big|_{T_2}^{T_1}; \qquad (1)$$

φ_D at the discontinuity and φ_T of the slow gradient between *C* and *D* The equilibrium condition (if one neglects the 'back diffusion') consists then simply in the equality of the numbers of electrons transmitted from both sides of the discontinuity. As the number of incident electrons on a surface increases with temperature, a potential difference must be built up, which retains the surplus from the hotter side. (It is assumed that the distribution function is not changed appreciably by the space charge, which, for good conductors, certainly is justified.)

In order to calculate φ_B, consider a chain as in Fig. 2 with two opposite jumps of temperature in two different materials. This chain does not give rise to an E.M.F. As, with our assumption, simple differences of currents from both sides have to be considered at all contacts, one can remove intermediate links without disturbing the balance. At this point it is essential to neglect the back diffusion, as, otherwise, the numbers of electrons outgoing from both ends of the link A–B will not be the same. Furthermore, one has to assume that the number of electrons for unit surface, which are retained by a given potential difference, does not depend appreciably either on temperature or on the nature of the metal. This condition is fulfilled, if the electrons are in a state of high degeneration, that is for all ordinary metals.

If we transpose in the above sense the 'hole' at B to the contact at A, and D to C, a symmetrical arrangement remains (one metal at T_1, the other one at T_2, and at both contacts a sharp jump of temperature) and, therefore, neither chain (the transposed or the original one) can give rise to any current.

If we substitute in the original chain a slow transition of temperature in solid material for the sharp discontinuities at B and D, there remains simply an ordinary thermocouple with a corresponding E.M.F. $F_{\mathrm{I,II}}$. If we write down this balance we obtain the relation:

$$0 = F_{\mathrm{I,II}} + \left(\varphi_D \Big|_{T_2}^{T_1} - \varphi_T \Big|_{T_2}^{T_1}\right)_{\mathrm{II}} - \left(\varphi_D \Big|_{T_2}^{T_1} - \varphi_T \Big|_{T_2}^{T_1}\right)_{\mathrm{I}} \quad (2)$$

or with (1)

$$- F_{\mathrm{I,II}} = \varphi_{B\mathrm{II}} \Big|_{T_2}^{T_1} - \varphi_{B\mathrm{I}} \Big|_{T_2}^{T_1}. \quad (3)$$

Now, the E.M.F. of a chain can always be written as the difference of two functions characteristic for each of the two constituents

$$F_{\mathrm{I,II}} = F_{\mathrm{I}} \Big|_{T_2}^{T_1} - F_{\mathrm{II}} \Big|_{T_2}^{T_1}, \quad (4)$$

and we obtain, therefore, by comparison with (3), the general result:

$$\varphi_B \Big|_{T_2}^{T_1} = F \Big|_{T_2}^{T_1}, \quad (5)$$

that is, the potential of our special Benedicks chain is a magnitude which can be described as an absolute thermoelectric potential for a single material. It is, therefore, of the same order of magnitude as ordinary thermoelectric potentials.

It is to be noticed that the above result, though independent of any special model, is only valid for a suitable contact and a sharp discontinuity of temperature. It represents clearly the maximum effect possible. But as, according to our present picture, the free path comes out rather large, especially for low temperatures, where it reaches macroscopic dimensions, it should not be impossible to measure this effect.

A more complete discussion, together with a kinetic derivation and a treatment of related subjects, will shortly appear in the reports of the Réunion Int. de Chimie-Physique, Paris, 1933 ("Act. Sci. et Ind.", Paris, Hermann) and the *Nachr. Goett. Ak. Wiss.*

Institut Henri Poincaré, **LOTHAR NORDHEIM.**
Paris.
Nov. 12.

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[1] Benedicks, *Ergebn. d. Exakt. Natw.*, 8, 25, 1929.

[2] "Handb. Phys.", vol. 13, p. 200.

Chemistry of Cheddar Cheese-making

SINCE its introduction by Lloyd in 1895 in the south-western counties of England, the determination of the acidity of the whey exuding from the curd has been regularly used by cheese-makers as a means of timing the manufacturing operations. The acidities are generally expressed as percentages of lactic acid in the whey. During the later stages of the process, it is found frequently that there is a fall in acidity in the whey, more especially after the salt has been added. No valid explanation has been put forward for this fall in acidity, apart from the obvious ones, namely, that the whey after salting is diluted with fat and salt, and the acidity might be expected to fall.

Determination of lactic acid in the wheys at various stages in the Cheddar cheese-making process have shown that there is a steady and continuous rise in the percentage present, even through the salting stage, despite the fact that the titratable acidity at this latter stage either falls or shows no appreciable rise. The rise in lactic acid content is accompanied by a very marked rise in calcium content (already noted by Lloyd) and the lactic acid is carried out in the whey as calcium lactate which does not exert any appreciable buffer action at hydrogen ion concentrations intermediate between the normal hydrogen ion concentration of wheys and the phenolphthalein end point.

Determination of the lactose content of whey has shown that there is a sharp fall in the percentage of lactose in the water of the whey liberated by the addition of salt at the salting stage. This is due to a diffusion outwards of water from the curd, and probably to a liberation of bound water from the curd. The addition of salt to curd at any of the earlier stages of the cheese-making process produces a similar sharp fall in the lactose content of the whey, calculated on the basis of the water content; whereas the whey from the unsalted curd shows a steady fall in lactose content. That rennet curd contains a considerable quantity of bound water is indicated by the fact that the proportion of lactose to water in the whey immediately after the curd is cut is greater than the proportion in the original milk, indicating that about 2 per cent of the water in milk is bound, that is, cheese curd will contain a quantity of bound water equal to about four fifths of its casein content.

An attempt to throw some light on the action of salt on cheese curd has yielded interesting results. Sodium sulphate was added to milk to give a concentration of 0·1 per cent SO_4 radicle. The proportion of SO_4 to water in the whey showed a slight fall until the salting stage was reached, after which there was a sharp rise of about 50 per cent, despite the fact already referred to above, that there is a dilution of the whey either by osmosis or by the liberation of bound water. No well-founded explanation is submitted for this observation, but it is suggested that the curd may be acting as a membrane and that the rise in SO_4 content is a Donnan equilibrium effect.

These matters are receiving further attention at this Institute.

F. H. MCDOWALL.
R. M. DOLBY.

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Nov. 2.

Condensation of Water in the Atmosphere

IN NATURE of December 16, p 938, it is stated "A number of workers, notably Defant, Köhler, Niederdorfer, claim to have shown that the volume of droplets in the atmosphere are most frequently integral multiples of some standard minimum size" The "law" claimed by Defant and Köhler is much more interesting than this statement implies.

In 1905 Defant measured raindrops : the smallest drops were less than 1/40th of a milligram in weight, while the largest were more than 100 milligrams.

The outstanding feature of the result which Defant claimed to have established was that the most frequent sizes (weights) of raindrops were in the ratio 1 2 · 4 8 16, etc. Defant found two such series In the principal series the unit was 0 115 mgm , and in the secondary series it was 0 35 mgm or three times as heavy Thus the two series can be represented as $1x$, $2x$, $4x$, $8x$, etc and $3x$, $6x$, $12x$, $24x$, etc where x is 0 115 mgm This immediately suggests three things

(i) Primary drops tend to be of the same size

(ii) Large drops tend to be formed by coalescence of drops rather than by continuous growth.

(iii) Gravity is an effective operating agent in the formation of compound drops

If one had (i) and (ii) alone, then drops would tend to be 1, 2, 3, 4, etc , times the primal drop ; that is, the integral multiple law would hold. The "law of 2" necessitates a sorting of the drops by the action of gravity. Such a sorting by gravity is indeed inescapable rain does fall on places not themselves in cloud I remember mentioning this twenty five years ago in a letter to the late Prof. Poynting about his note on the rate of fall of cloud drops in the first edition of the volume on "Heat" in the Text Books of Physics series, and in later editions he referred to Defant's work

These measurements by Defant were made with raindrops Kohler, many years later, measured the sizes of drops in fogs and clouds, and came to the conclusion that for these drops, also, the same "law of 2" held Those drops have a diameter 100 times less than Defant's raindrops, and weights 1,000,000 times less[1]. At that time I wrote . "Independent testimony—dare one hope from Scotland—is required of the 'law of 2' before it can be included among the established facts of meteorology". It appears from the article in NATURE of December 16 that not only does Scotland stand where it did, but that the testimony is not yet complete

E. GOLD.

8, Hurst Close, N.W 11
Dec 19.

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[1] NATURE, 119, 654, April 30, 1927

Measurements of Submarine Daylight

IN the course of the last nine years Poole and Atkins[1] have developed a very ingenious method for measuring the intensity of the daylight penetrating into the sea by means of alkali-metal photo-cells, using a delicate balance method for measuring the very weak photo-currents. The many vagaries of the photo-cells make measurements with this contrivance rather difficult to any but trained experimenters In order to find a simpler and less expensive method of measuring submarine daylight we have used the novel 'Sperrschicht' selenite photo-cells due to Dr B. Lange. As these cells give a photo-current several hundred times more intense than the most sensitive of the alkali cells, it is possible to use an ordinary pointer galvanometer, or some similar instrument, for the observations, while at the same time they are simpler and more easily manipulated by relatively untrained observers. The instrument used for our measurements gave a deflection of one scale-unit for 3 76 × 10^{-7} amperes and could be read to within 0 1 scale-unit. Another advantage of the Lange cell is its broad maximum of sensibility between 4500 and 5500 A., that is, with its centre near the minimum of light-extinction found by Knudsen for coastal water at 5100 A. The narrow region of maximum sensibility characteristic of the potassium cell is situated much nearer the violet end of the spectrum

We have been using the Lange cell, protected from the water by a thick disc of plate-glass, externally roughened, within a strong box of brass, into which a rubber-insulated cable holding two 0 75 mm.^{2} copper wires for the photo-current passes from below Readings taken, first when the instrument was being lowered into the sea, then repeated at the same depths while it was being raised to the surface, agreed closely *inter se* and showed characteristic variations in the transparency, apparently due to plankton or to detritus suspended in the water On a clear day in August the submarine daylight in the central Baltic Sea could be measured by this simple contrivance down to a depth of 50 metres. With the cell inverted, its sensitive surface facing downwards, the light scattered upwards could be measured down to 25 metres.

Two similar instruments combined with a registering galvanometer have for the last three months been used for recording continuously the variations in submarine daylight in the Gullmar Fjord, here suspended from our observation pier, one in 15 metres depth and the other cell one metre below the surface. We believe the instrument will become useful to oceanographers for making rapid surveys of the transparency of the water at different depths and also for studying the relationship between the light-factor and the flowering of the phyto-plankton. A more detailed report is being published in *Meddelanden från Goteborgs Högskolas Oceanografiska Institution*

HANS PETTERSSON.
SVANTE LANDBERG

Bornö Station.
Nov.

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[1] *J Marine Biol Assoc* , 14, 177 ; 1926 ; 15, 485 , 1928, 16, 297 , 1929 Also *Biol Bulletin*, 65, 317 , 1933

Structure of Collagen Fibres and the Point of Attack by Proteolytic Enzymes

SOME recent work by Bergmann and his colleagues has shown that the action of trypsin on gelatin gels is limited to the surface of the gel[1] and that the action on fresh collagen fibres is limited to the cut ends of the fibres[2], the enzymes having apparently no power to attack the fibres from their sides. Some observations made here on the penetration of bacteria into putrefying hide suggest that the same generalisation can be applied to the bacterial proteases.

It has been observed that the organisms penetrate the experimental pieces most readily from their cut edges and from the inner or 'flesh' surface, penetration from the outer or hair surface being very slow. According to Kaye[3], the reticular fibres of skin, which hold the collagen fibres and fibre bundles together, are readily attacked by bacteria. Bacterial penetration between the collagen fibres can occur therefore through the hydrolysis of the reticular fibres

A microscopical study of the penetration of bacteria suggests, however, that the sides of the collagen fibres have considerable resistance to the action of the proteolytic enzymes of bacteria. It is well recognised that keratins are resistant to proteolytic enzymes and the resistance of the hides to penetration of bacteria from the hair surface is doubtless due to the keratinous outer layers of the epidermis It was recently observed, in examining a consignment of hides from Kenya, that putrefaction commonly occurred along brand marks and cuts on the flesh surface caused by bad flaying, even when the rest of the hide was free from any sign of taint. The putrefactive bacteria evidently gained access into the hides at the cut ends of the fibres on the flesh side and through the epidermis where it had been thinned and changed in character as in the regeneration that follows after burning, that is, in the condition found in a brand mark The fact that the brand marks had been denuded of their protecting hair may also play some part in the greater tendency of these parts to putrefy—more organisms having possibly been deposited on them during the curing process. These hides were a consignment cured under experimental conditions through the co-operation of the Government of Kenya and the Imperial Institute, by the courtesy of which we were able to examine them

The suggestion that proteolytic enzymes can attack collagen fibres with ease at their cut ends, but only with difficulty at their sides, is in accord with the molecular structure of collagen fibres recently suggested by one of us[3]. It is also in accord with the demonstration made by Marriott[4] that the shearing strain of the cutting tool alters the character of the collagen, making it take on the properties of gelatin This change can now be interpreted as due to a change in molecular structure rather than chemical nature.

D JORDAN LLOYD.
M E. ROBERTSON
British Leather Manufacturers' Research Association,
20, St. Thomas St ,
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[1] M Bergmann and F Töhr, *Biochem. Z* , 264, 246 , 1933

[2] M. Bergmann, G Pojarlieff, H Thiele, *Collegium*, 582 , 1933

[3] D Jordan Lloyd, R. H Marriott, W B Pleass, *Trans Faraday Soc* , 29, 554 , 1933.

[4] R H Marriott, *J. Internat. Soc. Leather Trade Chem* , 1932

Mr. H. R. A. Mallock, F.R.S.

THE obituary notice of the late Mr. Mallock in NATURE of January 6 refers to his experiments on the trajectories and extreme range of rifle bullets. It was in 1896 that I began an association with Mr. Arnulph Mallock which continued actively until his health failed a few years ago. He was always interested in rifle matters as well as in big guns, and first came to me at the suggestion of the late Sir Henry Halford, whom he knew through Mr W E. Metford, to consult me as to an optical rifle sight which he had devised. Together we made at various times many experiments, such as one on the rate of increase of the velocity of a bullet when fired ; a ballistic pendulum was used and the barrel was cut down by stages. In connexion with questions of air resistance, he also carried out trials with bullets having a velocity as high as 4,000 ft. per sec., using for this purpose a special cordite and a bullet of spherical shape

The notice in NATURE mentions Mallock's work in ascertaining the extreme range reached by rifle bullets, about which no great certainty existed, by a new and successful method It was in 1910 and 1911 that, by the kindness of Sir Andrew Noble, we were enabled to fire into the water parallel to a long stretch of shore on Loch Fyne, Mallock with other observers taking up positions approximately opposite the point at which the bullets fell into the water when fired with increasing angles of elevation. It had been thought that in calm conditions—for calm was in any case essential—the splash made by the bullet would be visible, but beyond 2,000 yards it could not be seen However, the 'plop' of the bullet as it struck the water could be heard, and it was found by all who assisted that its direction could be located with unexpected accuracy and plotted in relation to the opposite shore half a mile away. In this way groups of shots were mapped. Shooting was done on five days in the very early mornings, and the 0 303 in. rifle was fired with different loads, and also the 0 280 rifle, up to extreme range. It was found that with the present pattern of 0 303 Service cartridge (Mark VII), then newly adopted, the extreme range was 3,400-3,500 yards, the height reached by the bullet being about 3,500 ft. and the time of flight about 28 seconds. The angle giving the maximum range was a little more than 30°, firing with angles of 35° and 40° showed the shortening of the range. The method of firing into water for long range trials has since come into use in Great Britain and elsewhere.

Mallock, in the years before his marriage, habitually worked through the night at his laboratory in Victoria Street, to avoid interruption. There were a surprising number of directions in which he applied his great knowledge, which was always at the service of others. It may be worth noting that he always firmly believed the helicopter to offer the final solution of the problem of safe and practical flying. He had great musical gifts, and an amazing memory, which made his conversation full of interest.

COTTESLOE.

Swanbourne,
Bletchley,
Bucks
Jan. 6.

Leonids Observations from an Aeroplane

THE weather conditions in November 1933 being unfavourable, it was decided by the United Czechoslovak Observatories, (National Observatory, University Observatory, Stefanik Observatory) to use an aeroplane for observations of the Leonids

Opportunity was given by the Czechoslovak Government and the Public Airlines Company to provide a three-engined Fokker for meteor observations. According to C. C. Wylie, in *Popular Astronomy*, 41, p. 170, the maximum was to be expected in the night of November 16–17. On this date the night was thoroughly cloudy and all preparations for the flight being made, the Fokker left the airport of Prague at $1^{h}\ 30^{m}$ (M.E.T.). There were three observers : Dr. E. Buchar, Dr. V. Guth, Dr. H. Slouka, one assistant, Mr. Bláha, the pilot and the radio-operator. The first observations were made at a height of 1000 m. but growing clouds and mist forced the pilot to ascend to 3000 m. The view of the observers was somewhat limited by the wings; Dr. Guth, who was at the rear window of the aeroplane, had the best view The windows were open and the fields of view were estimated in square degrees

The following observations were made

Nov 17 Time 1 30 2 30 (M E T)

Observer	Field of view in square degrees	No of meteors	No of Leonids
Bláha	1000	2	2
Buchar	1200	5	5
Guth	2500	12	10
Slouka	1200	4	3

Contrary to expectation, this year's Leonids were decidedly few, or the maximum was shifted a few hours or days and was not observed because of bad weather

The usefulness of aeroplanes for meteor observations was proved beyond a doubt, and preparations are being made for the modification of an aeroplane so that the observers will have an unlimited field of view HUBERT SLOUKA.

Astronomicky Ustav,
Karlovy University,
Prague
Dec 23

External Leaf-Characters of the Cricket-Bat and other Willows

IN a recent paper, Dr J Burtt Davy gives photographs showing the size and spacing of 'surface dots' on the upper side of the leaves of *Salix alba* L, *S. fragilis* L and × *S. viridis* var *elegensis*[1] It has been suggested that these surface dots, which occur in willow leaves generally, may be of diagnostic value in determining the true cricket-bat willow, *S alba* var *cærulea*, Smith; and an investigation of this feature has accordingly been undertaken.

The 'surface dots' represent *stomata*, which in willow occur on the upper as well as on the lower surface of the leaves, and it must be fully recognised that the evidence of many independent workers indicates that there is no diagnostic value in the size of stomata, or in their number per unit area of the leaf[2]. Such, in general, after an examination of a large number of leaves, is my own conclusion with regard to the various species of willow

It is, however, possible that if completely comparable mature material of different species and varieties, grown under exactly similar conditions of soil, water-supply and exposure to light and air, could be used, rough estimates of stomatal frequency might be made with the aid of a good lens, which might be of some help in diagnosis From an examination of such comparable material, *S alba*, for example, was found to have roughly twice as many surface dots as *S fragilis* Actual counts of the number of stomata per square millimetre were made by removing the epidermis from leaves by means of a weak macerating agent, and examining microscopically The counts were most probably comparable, for the material was treated in the same way in the different cases, and was in the same condition before treatment; they gave an average of 114 per sq. mm. for *S. alba*, and of 50 for *S. fragilis* It must not be concluded, however, that 114 and 50 represent the *actual* number of stomata per sq. mm when the epidermis was in position on the leaf; for the area of a *detached* portion of epidermis is not necessarily the same as when held in position by the underlying leaf-tissues; epidermis may shrink or stretch when removed, according to the condition of the underlying tissues

Unfortunately, surface dots did not provide a diagnostic difference between *S alba* and var *cærulea* in the comparable material examined, for the number was approximately the same in the two cases (113 per sq mm in var *cærulea*). Dr. Burtt Davy notes that Dr. Floderus, of Stockholm, is unable to recognise var *cærulea* as distinct from *S alba*[3], it was certainly not decisively differentiated by the frequency of the stomata in the leaves for which counts were made Further, it must be noted that surface dots do not provide a reliable means of distinguishing × *S viridis* var *elegensis* from *S. alba* in the field

Mention may also be made of the hairiness of the surfaces of old leaves of *S. alba* and var. *cærulea*. It is frequently stated that such leaves of var *cærulea* are glabrous on the lower side, and that they are thereby distinguishable from those of *S alba* They were, however, found not to be consistently glabrous, var *cærulea* is thus not certainly distinct from *S. alba* in this character also, for, like the spacing of stomata, hairiness is a surface feature varying with external conditions

These notes are contributed by way of warning field-workers on the bat-willow problem that external leaf-characters do not provide consistent and reliable diagnostic data unless used with extreme discretion.

H BANCROFT.

Imperial Forestry Institute,
University of Oxford
Dec 20

[1] "The Cricket bat Willow Problem" Reprint from *Quart J Forestry*, 1932

[2] See Odell, M E, "The Determination of Fossil Angiosperms by the Characters of their Vegetative Organs" *Ann Bot*, 46, 941 Note especially pp 951-56 and references

[3] *loc cit*, p 7

The Term 'Mesolithic'

I HOPE I may be allowed to call myself an archæologist, although a very humble one, yet I find myself in complete disagreement with my friend Mr Reid Moir in NATURE of December 30, p 1006. After C. J. Thomsen[1] had in 1836 revived the idea of Lucretius[2] and divided the past history of man into the three ages of stone, bronze and iron, there was one stone age, but when the discoveries of Boucher de Perthes had been recognised by English savants, Sir John Evans[3] in 1859 pointed out that this age must be divided into two, that in which the *fauna* was extinct and that in which it was recent. Later on, Sir John Lubbock[4] suggested that these two periods should be termed respectively the palæolithic and neolithic ages. It was soon noted, however, that these ages did not pass into one another, but that between them there was a great gulf fixed, and this became known as the great hiatus

About the same time an opportunity occurred to bridge this gulf, for in 1860 Profs. Steenstrup, Forchhammer and Worsae were appointed a committee to investigate the shell-mounds that had recently been discovered on the shores of Jutland[5]. These savants differed as to where this culture was to be placed, for, whereas Worsae suggested that these remains should be relegated to a late phase of the Old Stone Age, Steenstrup allotted them to the true Neolithic Age To effect a compromise, Lubbock suggested that these remains should be referred to an early Neolithic period[6], in which they remained for many years.

By degrees other industries were found which could neither be placed in the Old Stone Age or the

New, and matters came to a head with the discovery of the deposit in the cave of Mas d'Azil, first explored by Piette in 1887[7], and continued for several years. The study of these implements led him in 1895 to suggest that there was a transitional period between the Palæolithic and the Neolithic Ages[8] He had, however, been anticipated in this, for on March 8, 1892, Mr John Allen Brown read a paper before the Anthropological Institute, postulating the existence of a Mesolithic Age[9]

The paper by Piette, the remains from the cave of Mas d'Azil, the microlithic industry found by E Vielle in 1879 in the park of the Chateau of Fère near Fère-en-Tardenois[10], and the early culture found in 1903 by Sarauw at Maglemose[11], persuaded the archæologists of France to insert a transitional phase between the Old and the New Stone Ages. This was clearly set out by Déchelette in 1908[12], though in deference to the views of the Danish archæologists he excluded from this phase the culture of the shell-mounds, which he left standing alone in an early Neolithic Age This treatment was followed by Sollas[13] in 1911 and 1924, and by Burkitt[14] in 1921, but in the latter year Macalister[15] boldly included the shell mound culture in a period that he called Mesolithic

The advantages of this new arrangement seem obvious Palæolithic remains are found associated with an extinct *fauna* and glacial or interglacial environments True Neolithic remains are associated with agriculture, domesticated animals, pottery and ground or polished implements There are, however, cultures that have neither kind of association and lie for the most part between the two others in time What more natural than to treat them as a series apart and call them Mesolithic ?

At first some writers, notably Gordon Childe[16], feeling that these cultures were really rather an appendix to the Palæolithic Age than an entirely new phase, used for them the term Epipalæolithic, a name first introduced by Obermaier in a slightly different connotation It is undoubtedly more logical, but Mesolithic has the advantage of being shorter and so has won the day At last, after a struggle of nearly forty years a Mesolithic Age has been adopted by all archæologists except Mr Reid Moir

The Museum, HAROLD J E PEAKE
Newbury
Jan 1

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[1] Thomsen, C J, "Ledetraad til Nordisk Old Kyndighed" (Copenhagen, 1836)

[2] Lucretius, "De Rerum Natura", 5, 1282–96

[3] Evans, J, in *Archæologia*, 38, 293 cf *Phil Trans*, 311, 1860

[4] Lubbock, J, 'On the evidence of the Antiquity of Man afforded by the Physical Structure of the Somme Valley", *Nat Hist Rev*, 144–169, 1862 *Prehistoric Times* (London, 1865)

[5] "Undersögelser i geologisk-antiquarisk Retning af G Forchhammer, J Steenstrup, og J Worsae cf also *Mem Soc Vaudois*, 6, 1860

[6] Lubbock, J, "Prehistoric Times" (London, 1865), p 196

[7] Piette, E, *L'Anthropologie*, 5, 129–146, 6, 276–292, 7, 1–17, 309, 385–427, 14, 641–653, 18, 1–11

[8] Piette, E, " 'Hiatus et lacune', vestiges de la période de transition dans la grotte du Mas d'Azil" *Bull Soc d'anthrop Paris*, Ser iv 6, 235 cf also *L'Anthropologie*, 6, 276

[9] Brown, John Allen, "On the continuity of the Palæolithic and Neolithic Periods", *J Anthrop Inst*, 22, 66–98, 1893

[10] Vielle, E, "Pointes de flèches typiques de Fère-en-Tardenois", *Bull Soc d'anthrop Paris*, Ser. iv, 1, 959, 1890

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Influence of Pressure on the Spontaneous Inflammation of Hydrocarbons

NEARLY a year ago we investigated the conditions of spontaneous inflammation in mixtures of pentane and oxygen at pressures from 5 cm to 140 cm by admitting the gases into an evacuated metal vessel. We were not satisfied with the data obtained, since the experimental points showed considerable scattering, and the work was therefore not published

The curves obtained by us for the mixture $C_5H_{12} + 8O_2$ in an iron bomb and in a bomb the inner surface of which was covered with gold (Fig 1) have sharp kinks in the region of 60 cm We were, therefore, able to draw the conclusion that there are two different ways in which the oxidation may proceed, each of which prevails in a definite region of pressure.

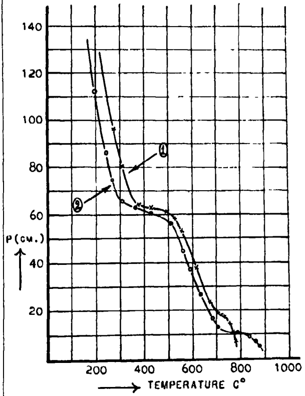

FIG 1 Pressure-temperature curves for spontaneous inflammation of the mixture $C_5H_{12} + 8O_2$ in (1) iron vessels, (2) gilded vessels

Townend and Mandlokar[1] have recently investigated the inflammation of butane-air mixtures and have found that the curves have distinct breaks in the pressure region between 1½ and 3 atmospheres. They explain this fact on Bone's hydroxylation theory .

$$\begin{array}{ccccccc} R\,CH_3 \rightarrow & R\,CH_2OH & \rightarrow & R\,CHO & \rightarrow & R\,COOH & \rightarrow \text{etc} \\ & \downarrow & & \downarrow & & \downarrow & \\ \overline{RH} + & CO & \overline{+ H_2} & \overline{RH} + & \overline{CO} & \overline{R\,OH} + & \overline{CO} \end{array}$$

At high pressures, ignition probably arises as the result of the rapid oxidation of an aldehyde or other intermediate oxygenated product which may occur at temperatures of about 300° C.; at low pressures, conditions are more favourable to the thermal decomposition of these bodies into hydrogen, carbon monoxide, methane, etc., the ignition of which does not occur until much higher temperatures have been attained.

This hypothesis finds support in work carried out at the Leningrad Institute of Chemical Physics. Thus Kovalsky[2] has found that at low pressures the oxidation of methane is accompanied by the formation of carbon monoxide in large quantities. Sadovnikov[3] has recently shown that at low pressures, during the inflammation of ethane-oxygen mixtures, carbon monoxide accumulates and then explodes.

From our own experimental results, we are able to apply the above hypothesis, used for butane mixtures, to pentane mixtures. The existence of a sudden lowering of the inflammation temperature at any critical pressure may therefore be considered to be quite general for the inflammation of complex hydrocarbons.

It is possible that this fact is closely connected with the increased probability of knock with increase of compression ratio in internal combustion engines.

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V. ESTROVICH.

Institute of Chemical Physics,
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Leningrad 21.
Oct. 27.

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Raman Spectrum of Heavy Water

THE Raman spectrum of 80 per cent heavy water obtained with a sample supplied by Prof. H. S. Taylor of Princeton, when compared with the spectrum of the 18 per cent material previously reported[1], shows that the water molecule with two atoms of heavy hydrogen gives a Raman band with a frequency difference of 2517, while the molecule with one atom of heavy and one of light hydrogen gives *two* bands, one of frequency difference of 2623, the other of 3500. Ordinary water gives a band with frequency difference 3445. A single photograph of a sample of given concentration does not bring out this shift as the bands overlap; but by superposing the *two photographs taken with different concentrations*, the shift in the centre of gravity of the bands comes out in a very striking manner.

Preparations have now been made for photographing the spectrum of the vapour, in which case we shall doubtless find double lines in place of the superposed and slightly shifted bands.

R. W. WOOD.

Johns Hopkins University,
Baltimore.
Jan. 2.

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[1] NATURE, 132, 970, Dec. 23, 1933.

Molecular Polarisations of Nitrobenzene in Various Solvents at 25° C.

A STUDY of the dielectric constants, densities and refractivities of dilute solutions of nitrobenzene in various solvents at 25° C. has been made in these laboratories with the following results:

Solvent	ε	$_\infty P_2$ c.c.	$_\infty P_{A+O}$ c.c.	μ
n-Hexane	1·887	372·5	339·9	4.049×10^{-18} E.S.U.
cyclo-Hexane	2·016	360·0	327·4	3·974 ,,
Dekalin	2·162	352·9	320·3	3·930 ,,
Carbon tetrachloride	2·228	353·1	320·5	3·932 ,,
Benzene	2·273	353·8	321·2	3·936 ,,
Carbon disulphide	2·633	310·0	277·4	3·658 ,,
Chloroform	4·722	241·2	208·6	3·172 ,,

$_\infty P_E = 32.6$ c.c.

where: ε = dielectric constant of solvent, $_\infty P_2$ = total polarisation of nitrobenzene at infinite dilution, $_\infty P_{A+O}$ = atom + orientation polarisation, $_\infty P_E$ = electron polarisation, and μ = apparent electric moment calculated from the Debye equation neglecting the unknown atom polarisation. The error of measurement of the polarisations is probably ± 0·5 c.c.

If $_\infty P_2$ for all these solvents is plotted against ε, a reasonably straight line is obtained, the polarisation of the solute falling with increasing dielectric constant of the solvent. It is to be noticed that the table contains a polar solvent, chloroform. Non-polar solvents have dielectric constants between 1·8 and 2·6 approximately, and possibly polar solvents of higher dielectric constants may prove as serviceable for the measurement of apparent dipole moment as non-polar ones. The right conditions for the accurate determination of the dipole moment of a molecule in solution has yet to be found. In the past the Debye equation deduced for a gas has been slavishly applied. It may not be valid for a solution.

A more detailed account of this work will be published later.

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Oxford.
Dec. 8.

Integral Right-angled Triangles

IN NATURE of September 9 and October 14 integral right-angled triangles have been discussed. It is of interest to note that in the general solution

$$2fg, \quad f^2-g^2, \quad f^2+g^2,$$

if we make f and g consecutive terms of the series

$$1, 2, 5, 12, 29, 70 \ldots$$

where $U_n = 2U_{n-1} + U_{n-2}$
we get triangles whose sides about the right angle differ by unity.

The first five triangles are

4	3	5
20	21	29
120	119	169
696	697	985
4060	4059	5741

The first one is used extensively by surveyors and others when constructing a right angle either on the ground or on a plan. The second, however, is a better 'conditioned' triangle and would be used if it were more generally known.

The law of formation of the series given above is the same as the law for forming successive convergents of $\sqrt{2}$ from the continued fraction.

Successive approximations to $\sqrt{2}$ can be obtained by dividing the hypotenuse by the mean of the other two sides of the triangles given here. If we take the fifth triangle and divide 5741 by 4059·5, we get $\sqrt{2}$ correct to one part in a hundred million.

F. S. RICHARDS.

Survey of Egypt,
Giza (Mudiria),
Egypt.
Nov. 19.

Research Items

The Capsian Industry. A preliminary reconsideration of the Capsian phase of the Stone Age in North Africa is put forward by M. R Vaufrey in *L'Anthropologie*, **43**, Nos. 5–6 in the light of the results of investigations in the shell-heaps of southern Tunisia in 1931–32 The evidence then collected gives an entirely different view of the Capsian industry from that generally accepted, according to which the Capsian is regarded as the ancestor of the Upper Palæolithic and the Mesolithic of Europe, and an upper and lower Capsian are distinguished, microliths being rare in the latter, the older culture. These investigations, which have been conducted in accordance with a more stringent method than that employed by previous investigators, show that the conception of an ancient Capsian composed almost exclusively of large implements is entirely due to an incomplete view of the evidence. More exacting methods of investigation show that *the microlith is abundant in this early stage*, and is already highly developed The Capsian, it appears, is *essentially one*, but is divisible *into three* chronological stages—a homogeneous body in which the microlith forms the binding material The three stages are typical Capsian in which points, burins and scrapers occur with a typical microlithic industry , (2) interogetulian neolithic or upper Capsian, in which the burin becomes exceptional, though scrapers are more or less numerous, while among the microliths, triangles and scalene points predominate, but true geometrical forms are rare, geometrical forms, however, characterising a divergent development in Algeria ; (3) neolithic of Capsian tradition, in which shell heaps are rare, the characteristic Capsian implement, the point *à dos rabattu* disappears, and evidence of Saharan influence appears Typologically the Capsian is late Palæolithic or Mesolithic, and does not belong to geologically ancient deposits. Hence it could not be the ancestor of Aurignacian, nor does it lend support to the African origin of *Homo sapiens*

Maya Archæology in South-West Guatemala In 1932 Mr and Mrs S. K. Lothrop made a reconnaissance of some thirty sites containing ancient remains and excavated the ruins of Chukumuk and Chuitinamit on the shores of Lake Atitlan in south-west Guatemala, a region archæologically almost unknown. In a report on the excavations ("Atitlan" Pub No. 444, Carnegie Institution, Washington) it is stated that the remains may be classified into several stylistic and chronological categories, and exhibit both strongly developed local characteristics and connexion with other areas Thus the most ancient types of pottery embrace non-Mayan elements which may have come from south and east ; but it is premature to decide whether it represents a transitional pre-Mayan population or a primitive Maya. The second pottery period shows connexion with 'early' Mexican culture as represented by Ticoman. It is related to late phases of Maya Old Empire as exemplified in Peten, western Salvador and western Honduras. At the same time it preserves non-Mayan elements of the previous schools. The last pottery period is typified by styles found at other highland sites such as Utatlan. As a whole, it has little resemblance to finds in other regions It is believed to cover the period of the political ascendancy of the historic highland tribes and ended with the Spanish conquest. Architectural features do not accord with those of other Maya remains. Ruined residences are of two kinds, which, it is believed, are of different epochs. As a whole, the remains indicate the early period in which the inhabitants drew inspiration from western Salvador and to a less extent from Central Mexico At a later period they were in contact with the Maya Old Empire, and in the centuries before the conquest developed a culture of strongly local type.

Di-iodothyronine in Myxœdema Although dried thyroid gland is physiologically active by mouth, the pure active principle, thyroxine, only exerts a comparable effect when given by injection it is generally supposed that this is due to failure of absorption from the gut, since thyroxine is very insoluble In the digestion in the intestine of the iodothyreoglobulin of the gland, a peptide of thyroxine is set free which is much more soluble than thyroxine itself, and so is readily absorbed The synthetic production of such a soluble peptide, however, has not been successful A derivative of thyroxine which exerts a significant amount of thyroid-like activity is 3 . 5-di-iodothyronine, which has the same structural skeleton as thyroxine but contains only two iodine atoms. Gaddum found that its activity was 1/15–1/40 that of thyroxine according to the method of test employed It is, however, more soluble than the latter, and this difference between the two compounds is still more marked in the case of their salts both with acids and alkalis The clinical value of the disodium salt in myxœdema has recently been investigated by A B Anderson, C. R Harington and D. Murray Lyon (*Lancet*, 1081, Nov 11, 1933) Daily doses of 50 mgm of the di-iodothyronine in water were given by mouth to six cases, and in each the basal metabolic rate was raised to, or nearly to, the normal level, the pulse rate was quickened and the weight was reduced when the patient was initially overweight. No toxic symptoms were observed with continued administration over periods of two to three weeks . on withdrawal of the drug, the metabolic and pulse rates fell and the weight rose again. The magnitude of the effects produced was similar to what might be anticipated from the daily injection of 1 mgm. of thyroxine Since di-iodothyronine can be prepared in the pure condition and moreover appears to exert its physiological activity with a remarkable degree of constancy, it may prove to be a valuable substitute for thyroid gland in all cases in which administration of the latter is indicated.

Structure of Larvæ of Hispine Beetles. An interesting case in which a study of the larval morphology has made it possible to correct the systematic position of the adult insect is offered by a recent paper of S Maulik (*Proc Zool Soc London*, 1933, part 3). The beetle *Platyauchenia latreillei*, Cast. has been referred to the subfamily Cassidinæ, but its larva lacks the prolongations at the end of the body which are used for carrying on the back of a mass of excreta, and constitute a character peculiar to larvæ of the subfamily Cassidinæ. On the other hand, the structure of the partially fused eighth and ninth segments of the abdomen is such as is often observed amongst larvæ of Hispinæ. Other larval and adult characters of *Platyauchenia* are discussed at length and it is concluded that the genus should be removed to Hispinæ At the same time the larva shows some modifications in the position of spiracles not previously recorded amongst Hispinæ, while its head, though that of a true miner, shows a structure different from any so far observed in other leaf-mining larvæ

Entry of Water into the Germinating Seed A study of the brief communication on this subject by Alexander Nelson and Jas C Macsween (*Trans and Proc Bot Soc Edin*, 31, Part 2) will dispel certain popular illusions The least study of the broad bean would show that the micropyle is far from being a hole permitting access of water to the interior of the seed, and careful measurements with beans floating in a 'lifebelt' of paraffin wax show that intake of water is about the same whether the half immersed includes the micropyle or not Reasons are given for concluding that two factors are at work in facilitating water entrance (1) the hydration of the colloids of the testa, (2) an osmotic action through the semi-permeable coat due to the release of carbohydrates in the inner lining of the testa Emphasis is laid in this paper upon the great variation in the behaviour of individual seeds

Growth of Evergeens According to the Science Service, Washington, D C, Prof Ansel F Hemenway, of the University of Arizona, has recorded evidence concerning the growth of the great evergreen trees of the Pacific north-west Prof Hemenway points out that the cambium, and also certain elongated cells, the function of which is considered by botanists to be the transportation of dissolved food substances, appear to be in active condition from early autumn until the commencement of the summer drought of this region In other words, that these species continue their growth throughout the winter Similar structures in deciduous or broad leaved species in the same region, and also in conifers and broad-leaved trees in Kentucky, do not appear to be functioning in specimens collected during the winter The Oregon broad-leaved trees also appear to have a period of little or no growth during the midsummer drought of the region It is thus apparent that there are two long periods in the year during which the broad leaved trees do not grow, whereas the evergreens are able to grow continuously through nine or ten months of the mild, moist autumn, winter and spring The author holds that the broad leaved species have lost the race for supremacy in the north-west coast region For this reason the forest of this region now consists almost entirely of Douglas spruce, grand fir, coast cedar and yellow pine

Geographical Distribution of Tea Cultivation Tea cultivation has a peculiar geographical distribution, *for apart from recent plantings in Africa and Russian* Georgia, commercial tea-growing is practically limited to the south-east of Asia and the adjoining islands, none being as yet carried on in America or South Europe The reasons for this have been recently discussed by H H Mann (*J Exp Agric*, 1, 245) The centre from which the plant originated, coupled with the availability of cheap hand labour, have naturally played an important part in the distribution of the crop as a commercial proposition, but despite these factors, the areas in which tea is grown are curiously limited. In certain directions the plant is very tolerant of variations in soil or climate, for it is found in comparatively temperate regions where frost is common and also in the neighbourhood of the equator In other respects, however, the crop are precise in its demands, certain conditions of soil and climate being essential for vigorous growth. Although most of the important tea estates lie on alluvial soils, the crop can be grown successfully on varied types provided certain physical and chemical conditions are satisfied In the first place, the soil must be deep and well drained, with a porous lower layer into which the roots of the plant can easily penetrate, and secondly, an acid reaction is essential, commercial success being unlikely if the *p*H is higher than 6 0 As regards manurial requirements the position is less clear Abundant available nitrogen is known to be important, but excessive quantities, particularly if not accompanied by adequate dressings of phosphoric acid and potash, prove harmful Recent work has, further, shown that other nutrients such as sulphur may sometimes be important, the diseased condition known as 'tea yellows' being attributed to a deficiency of this element

Long Beach Earthquake of March 10, 1933. The Californian earthquake of March 10, known as the Long Beach earthquake, is the subject of a valuable preliminary report by Mr H O Wood (*Bull Amer. Seis Soc*, 23, 43–56, 1933) Notwithstanding the great amount of damage caused in Long Beach and other towns, the shock does not belong to the class of great earthquakes, but was rather a fairly strong local shock originating near a thickly populated region From the records obtained at seven stations in southern California, the epicentre was found to be in about lat 33° 34 5′ N, long 117° 59′ W, or 3½ miles south-west of Newport Beach and in the general course of the Inglewood fault continued towards the south east The shock was felt in the ten southern counties of California and in a few places beyond, but serious damage to badly constructed houses was confined to an area of about 450 square miles, and was greatest in and near Compton and Long Beach No fault displacement was found at the surface The earthquake was followed by many after-shocks, some thousands being recorded by seismographs, but none of them comparable in strength with the principal shock, though a few increased the damage in buildings already injured

Acoustic Absorption In two recent papers (*Rend R. Ist Lombardo Sci Let*, Parts 11–15, 1933), Dr D Faggiani discusses the question of acoustic absorption by porous materials Previous theories which have been propounded lead to consequences which are not in agreement with the phenomena observed The new theory advanced by Faggiani is based on a consideration of the conditions of resonance of the very small channels into which the porous absorbing strata may be regarded as subdivided, and on the hypothesis that, in such conditions, the coefficient of absorption has, within suitable limits, a single value Application of these conceptions to the ideal case of a number of parallel channels of uniform radius and length leads to two conclusions which are in accord with certain of the empirical laws. Actually, in absorbent materials it may be assumed that the values for the lengths of the different channels are not constant, but are distributed about a certain most probable value When such variation is taken into account, there emerge further conclusions, all of which receive confirmation from the experimental data obtained by various observers with the most diverse porous materials.

Infra-Red Emission from Heated Metals. C. Hurst has recently published some observations on the emission of infra-red radiation by surfaces of copper and nickel (*Proc. Roy Soc.*, A, Nov.). The temperatures used were 700°–850° C for copper and 850° and 1,000° C for nickel, and the wave-length ranges lay between 1μ and 6 5μ. In the near infra-red region of the spectrum, the emissive properties change from 'optical' type to those characteristic of the electrical properties of the metal, and this change appears in the results of the present investigation The experimental method adopted was to compare the radiation from the metal surface with the black-body radiation from a wedge-shaped cavity in the metal The emitter was mounted in a vacuum chamber and heated by an internal tungsten spiral. The surface and the cavity were focused alternately on the slit of a rock-salt spectrometer, and the intensities compared by a thermopile and Paschen galvanometer A rotating sector cut down the black radiation to a convenient value for comparison The surface was prepared by grinding with emery paper and polishing with chamois leather, the metal was reduced with hydrogen to remove oxide films, and the values of the emissivity remained stable, in the case of copper, over weeks of work The experiments, taken in conjunction with the reflectivity measurements of Hagen and Rubens, made at room temperature, show that while the emissivity at short wave-lengths is not much affected by temperature, the emissivity at the longer wave lengths increases considerably with temperature as required by the classical electromagnetic theory The results have been compared with the theory of Kronig, who attempted to calculate with appropriate simplifying assumptions the motion of electrons in the periodic field of a metal lattice. The Kronig theory agrees less well with the experimental results in this region than does the classical theory of Drude, and the author shows that no simple modification of Kronig's theory is likely to explain the observed temperature variation of emissivity

Oscillations in an Ionised Gas It has been known for some time that oscillations may exist in a mass of ionised gas. R W Revans has recently described experiments in which stationary waves were set up in a bulb containing a hot cathode arc in mercury vapour (*Phys. Rev*, Nov. 15) In a 9 cm spherical bulb the strongest oscillation was just within the upper audible range, and a long train of harmonics could be detected The oscillations are apparently due to the vibrations of the glow as a whole comparably to those of the air in a Helmholtz resonator Over wide ranges of the arc current the frequency would remain constant and then at a certain value of the current the frequency would drop or increase suddenly due to a change to a different mode of vibration. The 'temperature' of the electron velocity distribution increases greatly when the glow begins to oscillate. A positively charged probe moved across the discharge showed maxima and minima in the collected electron current, indicating the presence of stationary waves The fundamental frequency agreed with that calculated from a formula of J. J. Thomson giving the velocity of waves travelling in an ionised gas The author intends to apply the idea of transmission of waves to the ionised atmospheres of stars, and in particular to disturbed areas such as sunspots.

Carbon Dioxide to prevent Ignition of Firedamp by Sparks. The Safety in Mines Research Board has just issued Paper No 81 on "The Prevention of Ignition of Firedamp by the Heat of Impact of Coal-Cutter Picks against Hard Rocks", written by Messrs M J Burgess and R V. Wheeler (H M S O , 6*d* net) It may be remembered that these same authors showed that firedamp could be ignited by the impact of coal-cutter picks against highly siliceous rocks They now point out that it is possible to prevent such ignition by discharging carbon dioxide into the cut made by the coal-cutter jib They arranged a flow of carbon dioxide by means of the solid form 'Drikold', manufactured for the market by Imperial Chemical Industries, Ltd , and usually in cylindrical blocks, 25 lb in weight, used in a standard liquifier, from which the gas could be delivered at known rates Their experiments are not very convincing, but their conclusions are that the possible ignition of firedamp when a coal-cutter pick strikes against a hard rock can be prevented by discharging carbon dioxide at the rate of at least 1¼ cub ft per minute into the cut Imperial Chemical Industries, Ltd , state that a continuous discharge of 1¼ cub. ft of carbon dioxide per minute would be obtained from 75 lb of Drikold, costing about 15*s* 6*d* As in 34 tests there were only 22 ignitions without the use of carbon dioxide at all, it is doubtful whether the coal mining industry will pay the price for a probable insurance against a possible accident, but the fact that a fair proportion of carbon dioxide prevents any ignition is decidedly interesting

The Gas Pressure Cable Recent progress in electrical engineering has been in the direction of ever-increasing voltages, but until quite recently this has not been accompanied by any radical change in cable design Up to 66 kilovolts, cables with solid insulating materials have proved satisfactory, but beyond this pressure new methods have to be devised In the *Electrical Power Engineer* of November–December 1933 an interesting lecture on this subject by Dr E. Bowden and F. W Main, given to the London Section of the Electrical Power Engineers' Association, is given in full The principle of the method used in the 'pressure cable' is to apply mechanical pressure radially to the insulation so that the vacuous spaces which tend to form in the material are either closed up or the pressure in them is raised to such an extent that no ionisation occurs The main difficulty to be overcome was to separate the pressure medium from the dielectric by an impermeable membrane. This was done by means of a thin lead sheath The gaseous pressure was applied from the outside, being confined in a pipe line The effect of this pressure produced a very marked improvement in the ionisation curve of the cable It was found that with nitrogen gas as the compressing medium, a pressure of eight atmospheres was sufficient to maintain the cable in a stable state. The first installation of pressure cable at 66 kilovolts on a commercial scale was completed about a year ago between Hackney and Walthamstow, the length of the line being about 2¼ miles The route went through a thickly populated suburban district and the pipes had to be threaded through gas and water mains, sewers, etc. The pipe is filled with nitrogen and a working pressure of 12 atmospheres is maintained The current carrying capacity of this type of cable is about 30 per cent higher than that of the usual type and its cost is about 25 per cent lower.

International Mathematical Congress Medals

EVERY four years there is held an international gathering of mathematicians, known as the International Congress of Mathematicians. At the next meeting, to be held in Oslo in 1936, two gold medals will be awarded to mathematicians selected for their outstanding contributions to mathematics by an international committee appointed for the purpose The foundation of these medals is due to the efforts of the late Dr J C Fields, research professor of mathematics at the University of Toronto Dr Fields was responsible for assembling the Mathematical Congress in Toronto in 1924—the only meeting which has been held outside Europe—and was president of the Congress and the editor of its *Proceedings*, which constituted two large volumes, published by the University of Toronto Press With funds remaining after the completion of the work, Dr Fields suggested the foundation of these medals, as a Canadian contribution to the cause of international scientific co operation, which he always had much at heart Unfortunately, Dr Fields did not live to see the realisation of his scheme, as he died in August 1932, a month before the meeting of the Congress in Zurich, which gave international approval to the foundation of the medals The medals will be awarded at each International Congress of Mathematicians in future

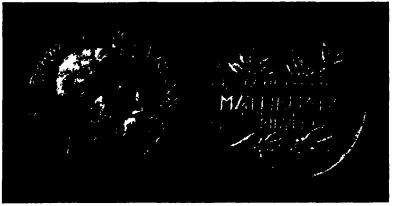

FIG 1 Medal of the International Mathematical Congress

In spite of the fact that the medals are of Canadian origin and are due to the personal efforts of Dr Fields, it was his particular wish that in design and award they should be truly international in character, and should not be associated with any country or person The task of designing a suitable medal was entrusted to the distinguished Canadian sculptor, Dr. R Tait McKenzie, R C A, who has now completed his work (Fig 1)

The medal is two and a half inches in diameter. The obverse shows the head of Archimedes facing right As there are no authentic portraits of this perhaps greatest of all mathematicians, recourse was had to the fine collection of more than thirty pictures collected by Prof. David Eugene Smith, and placed by him in Columbia University They show the idea of as many artists, ancient and modern, of what Archimedes may have appeared to be They naturally vary greatly, so the sculptor followed his own impression from reading his life and works He shows the sage as a man of mature age, vigorous, with curly hair and beard, straight Greek nose and prominent brow In the field is the word "Archimedous" in Greek capitals, and the artist's monogram, "RTM" and "MCMXXXIII"

The inscription surrounding it is: "Transire suum pectus mundoque potiri", which may be freely translated "To transcend one's human limitations and master the universe" This appropriate quotation from the Roman poet Manilius was supplied by Prof Norwood of the University of Toronto

The reverse has a label bearing the inscription. "Congregati ex toto orbe mathematici ob scripta insignia tribuere", which may be freely translated. "Mathematicians gathered together from the whole world honour noteworthy contributions to knowledge"

Behind the label is a laurel branch, and cut in the background can be made out the diagram of a sphere contained in a cylinder The determination of the relation of these two was one of the outstanding achievements of Archimedes, and this diagram was engraved on his tomb The name of the recipient will be cut on the edge of the medal and will not interfere with the design

Narcosis and Mental Function

IN a paper read before Section J (Psychology) of the British Association at Leicester, Dr J H Quastel, director of the Research Laboratory, Cardiff City Mental Hospital, gave an account of recent experiments with narcotics The evidence points to narcotics acting primarily by producing a state equivalent to anoxæmia at the particular parts of the nervous system where they are absorbed Also the psychological effects of narcosis and of oxygen want are very similar to each other.

The narcotic drugs tested have the common property of inhibiting, at low concentrations, the oxidation in the nervous system of substances important in carbohydrate metabolism, such as glucose and lactic acid, for which the effects are practically specific. If certain other substances are investigated which are freely oxidised by the brain, this inhibition of oxidation does not take place. The main effect of the narcotic appears to be at the nervous cells, where it interferes with the activation of the lactic acid molecule, a process which is necessary before its oxidation can take place. The narcotic and the lactic acid compete for the cell catalysts involved in the activation process

The following picture may be given of the mechanism of narcosis. Absorption of the narcotic takes place from the blood stream at a nervous centre There it competes with lactic acid for the cell catalysts, hindering the access of lactic acid to these catalysts and lowering the effective concentration of lactic acid available for oxidation. Hence the supply of energy is diminished; this produces a decrease in functional activity of the nervous centres in question and narcosis may ensue. It is clear from experiments—although much has yet to be done—that any mechanism resulting in deficient carbohydrate or lactic acid oxidation in the nervous system may well play a part in causing disorders of the functional activity of the nervous system.

The interesting question of the possibility of certain psychotic disorders having their origin in a state equivalent to oxygen deficiency at certain parts of the nervous system is thus raised. Evidence in favour of this possibility would be forthcoming if it could be shown that the body itself can produce substances which behave in a manner similar to narcotics This seems to have been accomplished by Quastel and other investigators at Cardiff. They have found that certain substances, mainly breakdown products of tyrosine and tryptophane, have precisely similar effects to those of the narcotics on the oxidation of glucose or of lactic acid in the brain at equivalent concentrations. Mescaline has a similar effect Most of the substances in question—tyramine, indole, and so on—are normally detoxicated in the body (chiefly in the liver), so that not more than traces can normally circulate in a healthy individual

A disturbance in hepatic functions, however, makes it not difficult to visualise the presence in the blood of more than ordinary amounts of these toxic substances, and their circulation over a long period would create a condition in the nervous system the psychological effects of which would be expected to resemble those found in anoxæmia or light narcosis Experiment has yet to show such a disturbance in detoxicating processes among certain psychotic types and attention is being focused on this problem

Prolonged narcosis as a therapeutic method, which seems to be satisfactory in certain cases in that it brings about an improvement in the mental condition, has been used in recent years Many, however, have abandoned it because of the production of toxic symptoms from the administration of the drug, which necessitated the cessation of this method of treatment before recovery was assured. A modified treatment of giving the patient a dose of glucose and an injection of insulin at the same time as the administration of the drug has proved very successful Ketonuria and other serious complications cleared up and the narcosis treatment became practically safe

Constitution of the Alloys of Iron and Manganese

THE latest contribution to the really remarkable work on the alloys of iron which has been carried out now for many years at the National Physical Laboratory is a paper by Dr. M. L. V. Gayler on the manganese-iron alloys, which was read at the meeting of the Iron and Steel Institute in September

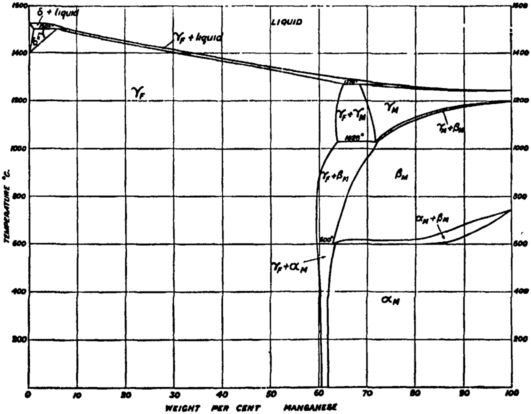

FIG. 1.

Fundamental work of this category demands as a preliminary the preparation of the elements themselves in a state of high purity. The iron employed was prepared electrolytically, treated in hydrogen at a temperature of 900°–1,000° C to remove oxygen, and then melted into ingot form in an induction furnace under hydrogen, being finally cooled *in vacuo* The manganese was distilled from the thermit product. The metals were then remelted in magnesia crucibles in an electric induction furnace, being allowed to solidify three times with intermediate remeltings prior to the final solidification To give an idea of the degree of purity of the final alloy the following composition of one with around 50 per cent of manganese may be cited carbon, 0 007, silicon, 0 023, sulphur, 0 014, phosphorus, 0 0013, manganese, 47 88 per cent

It is pointed out that the refractory materials available for the crucibles, thermo-couple sheaths, etc, has a profound effect upon the results in such work, and the analysis given above shows the extent to which the absorption of impurities by the metals from the refractories with which they have been in contact has been overcome To all workers with metals at very high temperatures the observations made upon the refactory materials which were tried will be of the greatest value The remainder of the experimental technique attains that high standard for which the work at the National Physical Laboratory in this field is famed

The diagram proposed is shown in Fig 1, reproduced from Dr Gayler's paper by courtesy of the council of the Iron and Steel Institute, which does not, however, contain data concerning the constitution of the iron rich alloys in the solid state This part of the problem still requires further work It will be seen that the δ transformation, which occurs at 1,504° C, extends from 1 to 8 per cent of manganese, after which γ-iron separates directly from the melt until the manganese content attains about 74 per cent Between 65 and 74 per cent of manganese a peritectic reaction occurs between this γ-iron and the manganese-rich liquid at a temperature of 1,270° C. to form a phase containing about 68 per cent of manganese With higher manganese contents, the solid solution containing the γ manganese phase separates directly from the melt

At the manganese end of the diagram the changes in the solid state have been determined with great care At a temperature of 1,028° C with a manganese content of from 64 to 72 per cent, the γ-manganese phase separates into γ iron and a β-manganese solid solution At 600° C a further transformation of the β-manganese takes place with the formation of γ iron and the α-solution of the manganese between 59 and 63 per cent of that element F C T

University and Educational Intelligence

IN "The Art of Teaching by Radio", Bulletin No 4 of 1933, the United States Office of Education has published a report intended to serve as a manual for those who aspire to broadcast the seed of learning That their number in the United States is large may be inferred from the fact that specialists in education by radio are employed on the staff of the Office of Education. It is indeed the senior member of this specialist staff who is responsible for the report, which is based on a very elaborate investigation conducted with the help of some hundreds of transmitting stations, the Association of College and University Stations, the National Association of Broadcasters, and other representatives of radio and educational interests It expresses a consensus of opinion among experts as to the best technique for preparing, advertising and transmitting educational programmes and as to preparing the ground for their reception by providing supplementary aids for listeners. Appended to it is a bibliography comprising ninety-one items, about a third of which have a European (chiefly British) origin It is a convenient summary, well adapted to serve its purpose Special sections deal with music, the drama, debates and dialogues.

SCHOOL administrators and teachers in the United States are exhorted by the Commissioner of Education in the September issue of *School Life* to co-operate in President Roosevelt's great national recovery scheme, so as to make school work a fitting preparation for life in the new world This formidable task is aggravated by the fact that the N R A code prohibition of employment of children less than sixteen years of age in industry and commerce automatically increases the school population by about 100,000 A more serious difficulty than the finding of accommodation for these additional pupils is the organisation of curricula suitable to the requirements of pupils of types for which the schools have not been accustomed to provide, and especially of those who have already been employed in paid work and are now obliged to go back to school This acute need for programmes of schoolwork appropriate to the requirements of 'working class' adolescents comes at a time when retrenchment policies have eliminated many of the courses in music, home economics, vocational guidance and the arts and crafts, and provisions for exceptional children The problem is discussed in an article entitled "The Children's Code" by one of the specialists in the Office of Education

FROM the Universities Bureau of the British Empire we have received a copy of a report of its executive council for 1932–33 The list of members comprises the nineteen universities of the British Isles, eleven Canadian universities (including all the larger universities except those of British Columbia, Manitoba and Montreal), the three principal Australian and the four South African universities, those of New Zealand, Malta and Hong-Kong and nine of the Indian universities Among the services rendered by the Bureau are the production of the "Year-book of the Universities of the Empire", the secretarial work of the Committee of Vice-Chancellors and Principals, the administration of certain trusts, including the Carnegie Corporation grant for enabling selected members of staffs of overseas universities to visit Great Britain, and assistance to overseas universities in the selection of candidates for academic posts Last year, the Bureau made arrangements for a visit of eight German professors (of theology, chemistry, medicine, English, ship- and airship-building, physics and architecture) to British universities No conference of the home universities was held, but regional universities' conferences were held in Australia (at Sydney in August 1932), South Africa (Vice-Chancellors' Committee of South African Universities, at Johannesburg in July 1932 and at Cape Town in February and June 1933) and India (Inter-University Board, at Hyderabad in February 1933). The report contains lists of subjects discussed at these conferences and at the quarterly meetings of the home universities' Committee of Vice-Chancellors and Principals. Appended to the report are fully annotated accounts for the year.

Science News a Century Ago

Phenology

The study of plant geography initiated by Linnæus and carried on by Humboldt and others was well advanced in the early years of the eighteenth century, but the study of the influence of climate on the growth of plants in different parts of the world was of later date. On January 22, 1834, Mr John Hogg addressed a letter to the *Philosophical Magazine* "On the Influence of the Climate of Naples upon the Periods of Vegetation as compared with that of some other Places in Europe" (vol 4, 1834, p 274), with the view of making the importance of this subject of study better known in England Most of the observations quoted are extracted from an Italian work on Naples or from Gilbert White, but Hogg was one of the first authors to attempt actually to work out the average dates of germination, flowering, fruiting, etc, of a number of plants in different regions, and to interpret the results in terms of climate, so that he may be regarded as a pioneer of the science of phenology.

Foundation of Electrochemistry

On January 23, 1834, and at meetings in two subsequent weeks, Faraday read before the Royal Society his important Seventh Series of the "Experimental Researches in Electricity" It is particularly in this Series, the outcome of his experiments in the autumn of 1833, that he establishes the principles of definite electro-chemical action upon which the science of electro-chemistry is based The paper contains his statement of the law "that the chemical power of a current of electricity is in direct proportion to the absolute quantity of electricity which passes", and a tabulation of 'ions' evolved on electro-chemical decomposition and the equivalent proportions in which they are produced, or their 'electro-chemical equivalents'. He describes in it his new instrument, "the only actual measurer of voltaic electricity which we at present possess", the 'volta-electrometer' or voltameter, and he defines the new terms, 'electrode', 'electrolyte', 'anode', 'cathode', 'anion', 'cation', he coined on the advice of Whewell and others

Magazine of Botany and Gardening

The following is an extract from a review by John Lindley, which appeared in the *Gardener's Magazine* of January 1834 "In Berrow's 'Worcester Journal', I have been shown the following advertisement: 'Published on the 1st of every month, the Magazine of Botany and Gardening, British and Foreign. Edited by J. Rennie, Professor of Zoology, King's College, London, assisted by some of the most eminent botanists in Europe; sixteen quarto pages of *original matter*.'—From the ingenious manner in which this is worded, it must doubtless be imagined by the public, as it was by the person who called my attention to the paragraph, that this original matter is furnished to Mr. Professor Rennie by writers whose names include mine. But, as I am not ambitious of the honour of being considered one of this gentleman's contributors, I shall be very much obliged if you will be so good as to allow me to state, through the *Gardener's Magazine*, that no original matter whatever has been either supplied or promised to Mr Professor Rennie by me. He has availed himself of some passages in works written by me, as he also has of others in the works of several of the writers mentioned in the advertisement; and this is, I presume, what is meant by being assisted; but, if so, the public should understand it rightly."

Fires in London

In a report on the fires in London in 1833 given in the *Mechanics Magazine* for January 25, 1834, it was stated that there were fifteen stations where men were on duty both day and night, four other stations were engines were kept, and at Kings' Stairs, Rotherhithe, there was a fire float. Although the steam fire engines patented by Braithwaite and Ericsson in 1829–30 had worked gratuitously at several fires in London with great success, there was prejudice against their use All the engines belonging to the Fire-engine Establishment were hand-worked, and were of the type introduced a century before by Richard Newsham, who by his invention of his "*engines for quenching fires*" it was said had given "a nobler present to his country than if he had added provinces to Great Britain". In 1834 there was no means of signalling to the fire stations and the watchmen on the bridges were often the first to give the alarm from seeing a reflection in the sky A shilling was usually given to the person who was the first to report a fire to a station, and by an Act of Parliament there were rewards respectively of 30*s*, 20*s* and 10*s*. to the first, second and third engines arriving on the scene. The number of fires attended by the Fire-engine Establishment in the year was 458, while there were 59 *false alarms* and 75 alarms from fires in chimneys The number of deaths through fire was twelve The London Fire-engine Establishment was founded by ten of the principal insurance companies on January 1, 1833, the headquarters of this concern was in Watling Street and Mr Braidwood was the superintendent.

Airy and Groombridge's Star Catalogue

Between January 11 and February 13, 1834, Airy, then Plumian professor of astronomy at Cambridge, was in London recuperating after a sharp attack of scarlet fever. During that time he drew up the papers for the Smith's prizes, which were awarded to Philip Kelland, of Queens' College, and Thomas Rawson Birks, of Trinity College, and began to examine the papers relating to the Star Catalogue formed by Stephen Groombridge. "I believe," he says, in his autobiography, "that it was while in London that I agreed with Mr Baily on a Report condemnatory of H Taylor's edition, and sent the Report to the Admiralty." Star catalogues had already been produced by many professional astronomers, including Bradley, Lacaille, Piazzi, Lalande, Argelander and Bessel They all entailed enormous labour and Airy said of Groombridge's Catalogue that, considering the circumstances, "the work is one of the greatest which the long deferred leisure of a private individual has produced".

Groombridge, who was born at Goudhurst, Kent, on January 7, 1755, was first a linen draper and then a West India merchant in London At his house in Goudhurst he set up a small observatory, but removing to Blackheath in 1802, he acquired a fine transit circle by Troughton with which in 1806 he began his catalogue. In about ten years he had accumulated some 50,000 observations, and he was engaged in reducing them when in 1827 he was attacked by paralysis. On his partial recovery he applied to the Board of Longitude for assistance in preparing the catalogue for the press. It ultimately appeared in 1832, the year Groombridge died, but owing to errors was suppressed Its revision was due to Airy. Elected fellow of the Royal Society in 1812, Groombridge was one of the founders of the Royal Astronomical Society He died on March 30, 1832 and was buried at Goudhurst.

Societies and Academies

LONDON

Society of Public Analysts, December 6 C. H Cribb: A specific gravity apparatus. In order to avoid the necessity for a water-bath with thermostatic control, the bottle, which has a thermometer stopper, is provided with a glass bulb sufficiently heavy to sink in any ordinary fluid and having a diameter about twice that of the neck of the bottle With this addition, the adjustment of temperature can be made to within a tenth of a degree in the course of a few minutes. G F. Hall and W. M Keightley · The excretion of aloes. Applying their modification of the Schoutelen reaction, the authors have shown that it is possible in some cases to detect unhydrolysed aloin in the urine for periods up to 60 hours after the aloes have been taken The unhydrolysed material can be detected at a later period than the hydrolysed drug, since the Schoutelen test is more sensitive than the Borntrâger test (for the hydrolysed drug) H E Cox · Chemical examination of furs in relation to dermatitis (4) Chemical reactions of dyeing with *p*-phenylene diamine and *p*-amino phenol A quantitative study of the oxidation of *p*-phenylenediamine by hydrogen peroxide in the presence of fur shows that the principal pigment formed is an azine combined with the fur proteins Some Bandrowski's base is found on the surface of the fibres, and there exists in the solution in the dye-bath much free *p*-phenylenediamine unoxidised, together with some Bandrowski's base and traces of quinone and ammonia Similar data are given in respect of *p*-aminophenol, which forms an oxazine in an analogous manner. The occurrence and properties of intermediate oxidation products in relation to dermatitis are discussed John Golding Use of the air-damped balance for the determination of total solids in milk Very rapid determinations of milk solids can be made by evaporating about 1 gm. of the milk in an aluminium cap (which cools very rapidly) and weighing the residue on an air-damped prismatic reflecting balance (Oertling) The influence of the time of drying on the results is shown in a series of tables G G Rao and K M Pandalai · Rapid method of determining minute quantities of nitrites. An iodimetric method has been devised in which the iodine liberated by the interaction of nitrous acid and hydrogen iodide is titrated in the presence of carbon dioxide evolved within the liquid itself. This prevents oxidation of the nitric oxide, also formed in the reaction, and expels it from the system, thereby eliminating the action of the resulting nitrogen peroxide on the iodide

PARIS

Academy of Sciences, December 4 (*C.R*, 197, 1369–1472). Emile Borel · The determination of the probability of series of rainy days and fine weather at the Parc Saint-Maur Hadamard: Observations on a recent note of Sixto Rios Reply to a criticism by Sixto Rios of a result of Mandelbrojt Gabriel Bertrand and Mlle. M. Andreitcheva: The comparative proportions of zinc in green and etiolated leaves There is a relation between the amount of zinc present in leaves and the coloration by chlorophyll. There is 2–3 times as much zinc in external green leaves as in the internal yellow leaves Where the etiolation is artificial the difference is greater. Louis de Broglie. The density of energy in the theory of light René Thiry was elected *Correspondant* for the Section of Mechanics. E J. Gumbel The limiting distribution of the greatest value amongst the smallest Richard Obláth. The theory of cubic constructions H Auerbach The number of generators of a limited linear group. René Dugas The establishment of Schrödinger's equation Bonnier and Moynot. The possible consequences of the use, in internal combustion engines, of hydrocarbons with a high antidetonating value. The adoption of anti-knock has not the same effect in all engines. In an engine which is normally in detonation, as is the case for many aviation engines, the change of the fuel produces a rise in the temperature of the escaping gases In engines less pushed, with little or no detonation, the variation of the escaping gas temperature is less marked Jean Chazy. The uniform integrals of the problem of three bodies Jules Géhéniau The fundamental laws of the L de Broglie wave in the gravific of Th De Donder Pierre Vernotte. The absolute measurement of the coefficients of thermal conductivity of gases. The apparatus described avoids the complication due to convection Michel Anastasiades. The mechanism of rectification in copper sulphide–magnesium rectifiers According to the author's theory, cuprous sulphide is produced from the cupric sulphide, and the rectification is mainly due to the contact Mg/Cu_2S. E Thellier. The permanent magnetism of fired earths A brick earth, heated uniformly in a magnetic field, is uniformly magnetised, this magnetisation depending on the conditions of time, temperature and atmosphere of the furnace The magnetisation is permanent. J Genard. The magnetic extinction of the fluorescence of diatomic molecules of sulphur The action of the magnetic field on the fluorescence of sulphur vapour is complex Some lines are extinguished, others appear to be unaffected, whilst some are strongly enhanced E Rinck Solidification diagrams of alloys formed by two alkali metals. The sodium-rubidium alloys No evidence was obtained of the existence of the compound Na_2Rb corresponding to the compound Na_2K. Pierre Auger and G Monod-Herzen The presence of neutrons in cosmic radiation. Marcel Godchot, Etienne Canals and Mlle. Germaine Cauquil: The Raman spectrum of some substituted cyclenic hydrocarbons. Jean Cournot and Henri Fournier: Comparative results of the measurement of corrosion. Albert Saint-Maxen and Emile Dureuil. The absorption spectrum of the diphenols in alkaline medium. The results confirm the hypothesis of Euler and van Bolin, relating to the existence of a compound of quinone structure in alkaline solutions of hydroquinol. Augustin Boutaric, Maurice Piettre and Mlle. Madeleine Roy: The physicochemical study of the flocculation of myxoprotein by resorcinol. Picon · The titanium sulphides. A description of the preparation and isolation of three new sulphides, Ti_2S_3, Ti_3S_4 and Ti_4S_5 B. Bogitch: The preparation of ferrochrome in the electric furnace Description of experiments on the semi-industrial scale on the direct reduction of chromite by retort carbon. AUGUSTIN MACHE: Contribution to the study of hydraulic mortars. A MAILLARD: The hydrogenation of naphthalene. A study of the causes of the anomalies found in the hydrogenation of naphthalene in the presence of catalysts. In the gas phase, there are two successive reactions producing the tetra and hexa hydrogen addition compounds. The reaction $C_{10}H_8 + 5H_2 = C_{10}H_{18}$ has not been observed D LIBERMANN: The preparation of the salts of trioxytriarylsulphonium derivatives of the para and ortho substituted phenols and on the arylsulphonium bases PAUL CORDIER The condensation of benzylpyruvic acid with benzyl cyanide. An acid nitrile is formed by this condensation. the corresponding dicarboxylic acid is unstable, it loses water and is converted by an isomeric change into the anhydride of an ethylene dicarboxylic acid ANTOINE WILLEMART Isomeric transformations of the hydrocarbons $C_{42}H_{30}$, isomers of 1, 3, 1′, 3′ tetraphenyl-1, 1′-dihydrorubene GEORGES RICHARD: An oxido-reduction of 1-chloro-1, 2-diphenylethanal and on a supposed tolane oxide MARCEL TUOT. Some ethylene and saturated hydrocarbons containing eight and eleven atoms of carbon PAUL GAUBERT. Liquid crystals produced by the evaporation or cooling of an aqueous solution of tartrazine. ROBERT LAFFITTE: The tectonic of the south of the massif of Aurès. ALBERT DE LAPPARENT The synclinal of Rians (Var) J P ROTHÉ Morphological observations at Scoresby Sound. RAYMOND CIRY: The eastern termination of the primary Asturian massif and the structure of the Mesozoic region which envelopes it towards the east G DEDEBANT: The envelopes of isobars F. M. BERGOUNIOUX: Remarks on the fossil Chelonians of the family of Amphichelydæ. W C DARRAH and P. BERTRAND: Observations on the flora of the Pennsylvanian coal measures (regions of Wilkes-Barre and Pittsburgh) MLLE A MICHAUX. The calcium contents of striated muscle and liver in normal guinea pigs and guinea pigs suffering from starvation, acute scurvy or chronic scurvy. RENÉ HAZARD: Potassium, an element producing adrenaline The effects produced by the injection of solutions of potassium chloride resemble those produced by adrenaline N KOBOZIEFF. The diversity of the genotypical constitution on mice with a normal tail. ÉTIENNE WOLFF. The experimental production of otocephaly and the principal malformations of the face in the fowl. D. BACH and D DESBORDES. The direct transformation of nitrates into ammonia by the mycelium of the lower fungi A and R. SARTORY and J. MEYER: The evolutive cycle of the Actinomyces in cultures after passage through a collodion ultra-filter. J. LAIGRET: The reproduction of murine leprosy in the guinea pig and rabbit, treated with an acetone extract of tubercle bacilli. VICTOR PAUCHET, PIERRE ROSENTHAL and HENRI BERTREUX: The treatment of surgical shock by fresh embryonic juices.

GENEVA

Society of Physics and Natural History, October 19. E JOUKOWSKY and CHARREY: A levigator with immovable liquid medium. The authors have constructed an apparatus in which the precipitation takes place in a cylindrical tube. A sand can be separated into a very large number of sizes, up to complete precipitation, and a large number of points on the curve of precipitation can be determined. LÉON W. COLLET: The gneissic mylonites of the southern side of the Tour Sallières. The author describes four different outcrops of gneissic mylonites in the sedimentary substratum of the Morcles Nappe. Two of these lenticles are located on the thrust plane of the Nappe. The two others are situated at the base of slices of the autochtonous rock and are in relation with crystalline wedges of the Aiguilles Rouges massif STUDER: Geological sketch of the neighbourhood of Renéville, French Congo

ROME

Royal National Academy of the Lincei, June 18 A. BEMPORAD: Stellar currents about R.A. $13^{h} + 52^{\circ}$ Decl. E ALMANSI: Deformations of elastic strips (7) P. VINASSA DE REGNY Age of the white chalk of Mount Casale, near Palermo Fossil studies show that the Mount Casale deposits must be ascribed, not to the Lower Lias, but to the Trias. L. PETRI: Ionising action of fresh vegetable tissue pulp and mitogenetic radiations. In continuation of earlier work, it is found that, with potatoes, the emission of mitogenetic radiations ceases and oxidation processes are greatly enfeebled when the tubers are cooked, whereas in the live tubers oxidising enzymes are very active A. DEL CHIARO An inequality of Jensen I. OPATOWSKI: Biharmonic functions as products analogous to Lamé's products, and the lines of force of Newtonian fields (1) J. C. VIGNAUX: A theorem on the double integrals of Abel and Laplace G. KRALL: Motion of a planetary system of $(n + 1)$ rigid bodies; its stationary limiting aspects Proof is given of the statement made in an earlier communication. celestial bodies having the structure of a planetary system, subject to tides or any internal dissipative actions, tend to have their baricentres on a straight line revolving with uniform velocity round the common baricentre in a plane determined by the initial data. A. COLACEVICH: Excess of colour and the *K* calcium line in interstellar absorption NELLA MORTARA. The use of liquid air for the purification of radium emanation B. ROSSI: The disintegration of lead by the effect of penetrating radiation. G. A. BARBIERI: A new type of complex compounds of bivalent silver. The anhydrous salt, silver picolinate, $Ag(C_5H_4N\,CO_2)_2$, is described. A BARONI Mixed sulphonic anhydrides (1) Preparation of acetosulphonic anhydrides Mixed anhydrides of acetic acid with methane-, ethane-, benzene- and *p*-toluene-sulphonic acids have been obtained by the action of the chlorides of the sulphonic acids on silver and sodium acetate. The mechanism of the decomposition of these anhydrides seems to be of the same type as that of mixed anhydrides of ordinary organic acids F P. MAZZA and A CIMMINO Dehydrogenase activity of *Bacillus coli communis* on higher fatty acids. Palmitic, oleic and, especially, stearic acid are dehydrogenated by this organism. The velocity of the action diminishes in the fatty acid series with increase of the molecular weight up to the C_8 or C_9 member and afterwards increases continuously. G. PICCARDI: Detection of europium, and three lines of extreme sensitivity. The flame spectra of certain mixtures of rare earth oxides revealed three intense europium lines of wave-lengths 4461, 4627 and 4594, which at low temperatures are highly sensitive. A. CHIARUGI: Development of the female gametophyte of *Weddellina squamulosa*, Tul (Podostemonaceæ). PAOLA PARDI: Contribution to the cariology of the Asclepiadaceæ B. DE LERMA: The pharyngeal bodies of the Orthoptera, proof of the existence of endocrine glands in arthropods.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, January 22

UNIVERSITY COLLEGE, LONDON, at 5 30 —S R K. Glanville "The Eastern Origin of Western Civilisation" *

EAST LONDON COLLEGE, at 5 30 —Prof J T MacGregor-Morris "Cathode Rays and their Use in Electrical Engineering" *

ROYAL GEOGRAPHICAL SOCIETY, at 8 30 —R Kaulback "The Assam Border of Tibet"

Tuesday, January 23

EAST LONDON COLLEGE, at 5 30 —Prof E C C Baly "The Photosynthesis of Carbohydrates from Carbonic Acid" *

Friday, January 26

GEOLOGICAL SOCIETY OF LONDON, at 4 30 —Joint meeting with the Royal Astronomical Society in the rooms of the Royal Astronomical Society, Burlington House, W 1 Discussion on the "Origin of the Earth's Major Surface Features"

ROYAL SOCIETY OF ARTS, at 8 —Hal Williams "Modern International Practice in Factory Design"

Official Publications Received

GREAT BRITAIN AND IRELAND

Brompton Hospital Reports a Collection of Papers recently published from the Hospital Vol 2, 1933 Pp iv+193 (London Brompton Hospital) 2*s* 6*d*

The Pharmaceutical Society of Great Britain Codex Revision Committee Report of Action and Uses Sub Committee Summary of Descriptions and Standards recommended by the Action and Uses Sub-Committee for Certain Substances to be included in the British Pharmaceutical Codex, 1934 Pp 14 1*s* 6*d* Report of Pharmacognosy Sub-Committee Summary of the Principal Standards for Crude Vegetable Drugs recommended by the Pharmacognosy Sub-Committee and accepted, provisionally, for inclusion in the British Pharmaceutical Codex, 1934 Pp 20 2*s* (London Pharmaceutical Press)

Old Ashmolean Postcards Oxford Science Series Men of Science of the 18th Century 6 cards in Monochrome (London Oxford University Press) 6*d* net

Electrical Equipment for London's Underground Railways Pp viii+83 (London British Electrical and Allied Manufacturers' Association, Inc)

Hull Museum Publications No 178 Record of Additions. By Thomas Sheppard Pp 32 No 179 Fact and Fiction in Geology By Thomas Sheppard Pp 20+2 plates No 180 Guide to the Museum of Commerce and Transport, High Street, Hull Edited by Thomas Sheppard Pp 36 No 181 Record of Additions By Thomas Sheppard Pp 48 (Hull)

The South Eastern Naturalist and Antiquary being the Thirty-eighth Volume of Transactions of the South-Eastern Union of Scientific Societies, including the Proceedings at the Thirty-eighth Annual Congress held at Norwich, 1933 Edited by Capt T Dannreuther Pp xlvi+119 (London) 5*s* net

Proceedings of the Society for Psychical Research Part 132, Vol 41, December Pp iv+331-382 (London Society for Psychical Research) 4*s*

Catalogue of the Twenty-fourth Annual Exhibition of Scientific Instruments and Apparatus, held at the Imperial College of Science and Technology, South Kensington, London, S W 7, January 9, 10 and 11, 1934 Pp 184+liv (London Physical Society)

OTHER COUNTRIES

Cornell University Agricultural Experiment Station. Bulletin 559 Social and Economic Areas of Broome County, New York, 1928 By Dwight Sanderson Pp 79 Bulletin 561 Economic Studies of Dairy Farming in New York, 11 Success in Management of Dairy Farms as affected by the Proportion of the Factors of Production By P H Stephens Pp 45 Bulletin 574 A Test of Floats as Fertilizer and a Study of the Influence of Farm Manure on their Effectiveness. By T L Lyon Pp 18 Memoir 147 The Comparative Value of Different Colonies of Bees for Fruit Pollination By A W Woodrow Pp. 29 Memoir 148 The Occurrence of Azotobacter in Peat Soils of New York By J K Wilson and B D Wilson. Pp 15 Memoir 149: The Character of the Peat Deposits of New York By B D Wilson and E V Staker. Pp 30. (Ithaca, N Y)

U S Department of the Interior Office of Education Bulletin, 1933, No 11 The Education of Spanish-Speaking Children in Five Southwestern States By Annie Reynolds Pp vi+64 (Washington, D.C Government Printing Office) 10 cents

Proceedings of the American Philosophical Society Vol 73, No 2 Pp. 71-126+5 plates. (Philadelphia.)

U S Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol 11, No 4, October, Research Papers Nos 600-608 Pp 441-586+30 plates (Washington, D C Government Printing Office) 25 cents

Malta Annual Report on the Working of the Museum Department during 1932-33 Pp xv (Malta Government Printing Office)

Ministry of the Interior Public Health Department Report on the Mission of the Research Institute, Public Health Department, and the Faculty of Medicine, Cairo, to Siwa Oasis, in January 1933, for the Study of Parasitic Infections, Malaria and Diphtheria By Prof M Khalil Bey Pp 21+5 plates (Cairo Government Press)

Smithsonian Miscellaneous Collections Vol 91, No 1 Station Records of the First Johnson-Smithsonian Deep-Sea Expedition By Paul Bartsch (Publication 3224) Pp ii+31+1 plate (Washington, D C, Smithsonian Institution)

The Indian Forest Records Vol 18, Part 10 The Physical and Mechanical Properties of Woods grown in India, Third Interim Report on Project 1 (Tests on Small Clear Specimens, including Results of Work done up to the end of 1932) By V D Limaye, under the direction of L N Seaman Pp iv+70+13 plates (Delhi Manager of Publications) 4 4 rupees, 7*s*

Journal and Proceedings of the Asiatic Society of Bengal New Series, Vol 28, 1932, No 1 Pp 377+23 plates 17 10 rupees New Series, Vol 28, 1932, No 2 Pp ccviii+3 plates 6 rupees (Calcutta)

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CATALOGUES, ETC

Radiostoleum the Industrial Application of a Scientific Achievement Pp 16 (London The British Drug Houses, Ltd.)

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Catalogue of B D H Fine Chemical Products (January 1934.) Pp 159 (London The British Drug Houses, Ltd.)

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The Chemist in Industry

DR. H. LEVINSTEIN, a past president of the Society of Chemical Industry, recently delivered before the Institute of Chemistry a discourse entitled "The Chemist as a Directing Force in Industry". While emphasising that there are other branches of special knowledge besides chemistry which are necessary to business, Dr. Levinstein declared that there can be no better training for industry in general—not alone for the chemical industry—than a sound training in science Too few in Great Britain have had such a training, too few of our business men, our politicians and our very able civil servants Yet mere knowledge or talent is not enough, "it is the man that matters" It is not necessary to be a chemist to control even a dyestuff manufacturing business, it is merely a great advantage to be one Chemists must not be regarded as one class, or as a class apart Chemical training is varied, but it cannot be more than an excellent preparation, what can eventually be accomplished depends on the individual or upon the opportunities which he can find or make

An increasing number of people who have had such training is being employed in administration in the big chemical and other industries, but there is no indication that politicians, financiers and bankers are making the slightest progress in this direction Finance houses and banks might well employ, as a routine procedure, men thoroughly trained in chemical industry. In Great Britain we have too little 'educated money', too little realisation of the value and applicability of the technologist's training and methods Inventions are too often regarded as accidental, whereas they are in truth created by researches directed to a specific purpose by trained minds Moreover, it is sometimes forgotten that the amount of a substance produced is not an accident, but is determined by the demands of trade, by the capital available, by the profits to be made, and often by the supply of raw material

As an example of the serious results of neglect of such considerations by those in authority, Dr. Levinstein quoted the payment of gold to the United States of America on account of war debts. Like every other industry, the gold mines of South Africa regulate their production of gold according to the demand which they can profitably supply. The cost of raising capital, economical and prudent working, and the world's requirements for their products are naturally their principal considerations The gold which we agreed to pay America—some 220 metric tons annually—is taken from stock. No effort is made to manufacture the extra quantity required from the raw material available in plenty, to earmark any portion of the new production of gold for debt payment, or to limit in any way the use of gold for unnecessary purposes In every particular we fail to take the elementary precautions which a trained technologist would have taken, had he been called upon to advise What should we think in business of a sales department which made contracts to deliver without consulting the manufacturing side or even the research department, which neglected to do every one of those things that are elementary in any properly conducted business ? During the years that currencies were being debauched in order to ship gold to America, India was taking almost as much gold as America, because our policy made it attractive Since Great Britain went off the gold standard, most of the gold which we shipped to India has come back, but after causing misery and poverty, undeserved and unnecessary, in every social class in half the world

Speaking of the relations between industry and the State, Dr. Levinstein referred to changes wrought by the War in many countries, and said that industrial history is being made very rapidly All political or social changes in one nation react remarkably quickly on all others Apart from the spread of new social theories, there is the fact that if the industries of one or two important States can act as a unit, a similar concentration or simplification in some form or other will be forced upon us. We already have compulsory quota and compulsory marketing methods, and trade agreements with other countries are likely to lead to novel restrictions on the construction of new plants Whereas up to now any person making an invention has been free to erect a plant to carry out his invention, it may in future be necessary for inventors or enterprising individuals who wish to be their own masters to obtain a permit before they can be allowed to build

The latter part of Dr Levinstein's discourse was devoted to an examination of the close relations between science and industry in Japan, and had special reference to the dependence of the pearl industry on scientific investigation and application Until a few years ago, the pearl industry of the East was as big a gamble as that of gold-mining before the introduction of the Forrest-MacArthur cyanide process, the pearl oyster was scarce, and the yield of good pearls was entirely a matter of chance. Now the breeding of oysters for pearls in Japan has become an industry analogous to the breeding of silk worms, the cultivation of the pearl oyster is recognised in Japan as a matter of national importance, and—this with reference to Mr Mikimoto, by whom the industry has been methodically built up—people who do things of national importance industrially in Japan are encouraged and honoured by those in high places The production of culture pearls, a delicate and lengthy operation described by Dr. Levinstein, is, as he said, truly a romance of science and industry in a novel form

Another great technical achievement is the development of the Japanese artificial silk industry. In fact, every industry which one looks at in Japan shows the same highly skilled planning, both on the technical and on the commercial sides Important technical results accrue from the work of the Institute of Physical and Chemical Research, which was founded in 1917, and has a trained research staff of four hundred Japanese industry is to-day armed with every weapon of the modern industrial armoury, and its competition is of importance to British chemical industry not only because Japan is a diminishing customer for chemicals, but also because the outlet for our inventions is half choked if the flow of orders from the great bleach works, dye-houses, and calico-printing works of Lancashire and Yorkshire is checked The intimate connexion between industry and the State is apparent; lost orders rapidly become matters of political importance. The problems involved call for the man of knowledge and action, and we agree with Dr. Levinstein that training in science, particularly if followed by works practice, gives that unique experience which aids in every type of constructive work

Everyman's Guide to the Plant Viruses

Recent Advances in the Study of Plant Viruses. By Dr Kenneth M. Smith Pp. xii+423. (London . J and A Churchill, 1933) 15*s*.

DR KENNETH SMITH is to be congratulated heartily on producing a succinct, clear, readable and excellently illustrated account of the present state of knowledge concerning the plant viruses In view of his many other activities the achievement is a remarkable one. The book will be of the greatest service not only to virus workers, but even more so to those in the related fields of botany, bacteriology and agriculture, to whom, for the first time, it presents a coherent account of the subject free from the minutiæ of technical papers

Beginning with an introductory chapter, the author passes to a consideration of symptomatology, which is a difficult and debatable subject, and then proceeds to a good account of pathological histology, including a useful comparison with animal virus diseases Two chapters are devoted to an excellent treatment of the physical properties of viruses, including practical directions for the preparation and use of graded collodion ultrafilters following Elford's method.

The next three chapters deal with insects in relation to viruses, and they are, as would be expected, excellent It is interesting to note that only three of the twenty-three orders of insects are implicated in the spread of plant viruses, and that the sub-order Homoptera contains about 90 per cent of all known vectors The evidence is presented *pro* and *con* on the unsettled question of the relationship between virus and insect, whether an obligate one and therefore leading to the presumption of a development cycle of the virus within its vector, or a casual physico-mechanical relationship The latter would appear to be favoured by the gradually accumulating evidence, notably the author's transmission of spotted wilt by means of *Thrips tabaci* in England, while it is associated with *Frankinella insularis* in Australia (which parallels the more doubtful case of curly top of sugar beet), the recently accomplished needle-transmission of the latter virus, and generally the discovery of multiple vectors for so many diseases, such as leaf-roll Further advances are likely to follow from Storey's delicate gut-puncturing operation on leaf-hoppers, whereby the virus gains access to the body fluids, as a result of which hoppers previously 'inactive' become vectors of streak.

Four chapters are devoted to the transmission of virus diseases by other means, to the physiology of diseased plants (a good account largely following Henderson Smith) and to general aspects of virus diseases, such as carriers, recovery, immunity, variations in virulence, virus adaptation, composite virus diseases and the separation of virus mixtures, all of which are succinctly and excellently treated

The last three chapters are made up of short descriptive lists, which are not exhaustive, of the virus diseases of plants. This is one of the least satisfactory parts of the book. Few will accept the author's grouping of the potato virus diseases, and it is remarkable that in the case of this crop alone does he confuse a virus with a virosis—a useful word which is rejected An attitude more detached and judicial would have led to a better treatment Those who are familiar with the author's papers will have some difficulty in recognising his best-known theories in their present form, but it is impossible to discuss this matter here. In any future edition it would be well to treat of crop losses and economic applications much more fully.

Taking the book as a whole, the outstanding features are the co-ordination of work on the animal and plant viruses, which workers in both fields will find stimulating, and the excellent bibliographies, brought down actually to the middle of 1933, for which alone the book would be worth its price These are appended to most chapters, and are not merely lists of titles, but are discussed so far as space permits One or two notable omissions may be referred to, such as the original discovery of the insect transmission of leaf-roll by Oortwijn Botjes in 1920, that of potato carriers by Atanasoff in 1925, and the finding of the *A*-chlorosis and *B*-chlorosis of the Malvaceæ by Hertzsch in 1927, whereby he reconciled the work of Lindemuth and Baur The book closes with an author and subject index, except for 16 pages of disfiguring publisher's announcements at the end

In a discipline so young, it may be asked which are the recent advances and which the older ? It will surprise most people to learn that potato mosaic was first seen by Orton, an American, in a German field in 1911, the irony of this being that not a single commercial American potato plant has since been found which is free from mosaic To this author's classical bulletin of 1914 we owe the specific name leaf-roll (philologically preferable to 'leaf roll') and the first mention of potato mosaic and streak With whom shall we begin the modern period ? With Orton, or Appel who inspired him, or Allard who conveyed the classical tobacco mosaic to potato in 1912, or Quanjer who discovered the infectious nature of leaf-roll in 1916 ? None of these papers is mentioned. The reviewer would say that the 'recent' period begins with Quanjer's paper of 1916, and he would like a student approaching the subject to do so in a filial and historical spirit, contrasting the trackless jungle of degeneration theories, from Parmentier downwards, which existed before

1916, with the path which was then so magically opened through it Or if 1916 is too remote, then he would say that the modern period begins with the general adoption about 1923 of the Wageningen greenhouse equipment and methods, which every country has copied, for all results of value have flowed from them

A striking feature of the bibliography is the immense preponderance of work in the English language Even if one were to admit that some of the other languages have not been gleaned so thoroughly, yet it is true that practically all the creative work (work in Dutch excluded) has appeared in English, and to this all the English-speaking countries have made first-class contributions, including besides Great Britain, Ireland and the United States, Australia, Africa, India and Canada

Virus workers—how long must we wait for 'virologists' [2]—have a gratifying esoteric feeling of working in a new medium in which anything may happen because it transcends the ordinary laws For this reason they have not been popular with their fellows, who have failed to understand what they are doing, if anything, except squabbling incomprehensively The present book removes this reproach, and virus workers themselves may, looking back over the labours of the last seventeen years, congratulate themselves *se valde profecisse* They have compiled a body of learning which fits the facts of Nature, explaining what was previously inexplicable, and their theories are still fruitful There is no other criterion of the truth PAUL A MURPHY

The Intimate Structure of Fibres

Fundamentals of Fibre Structure By W T Astbury Pp x + 187 (London Oxford University Press, 1933) 8s 6d. net

IT is a not uncommon complaint that the trend of thought in modern physics has been in such a direction as to make it almost impossible to devise an extended course of lectures suitable for extra-mural students The study of quantum theory, wave mechanics, potential barriers and the like demands a mathematical equipment and a technical knowledge quite beyond the compass of those whose training, in mathematics especially, has not been regular and systematic

That there is something in the complaint is seen in the practical fact that physical subjects do not bulk largely in adult educational syllabuses. Here and there, swimming rare in the vast whirlpool of courses on economics, music, and all possible cultural aspects of literature, may be found a lonely set of lectures on the history of the physical sciences or on some astronomical topic; but on the whole, physical subjects are poorly represented in such syllabuses—a very different state of affairs from that which held fifty or sixty years ago when, to hear Tyndall, crowds queued up at the Free Trade Hall as at a theatre The fault may be in the subject, or may be in the teacher

Mr Astbury's admirable lectures seem to show that, given an enthusiastic and clear-headed teacher, who speaks of what he really knows from first-hand acquaintance with the subject, an elucidation of some of the most recondite problems of modern physics may be satisfactorily presented to a lay audience

X-ray analysis, of course, lends itself specially to exposition by means of models—using that word in a very wide sense—and Mr Astbury has not been slow to avail himself of such assistance as models can afford He has not been afraid to begin at the beginning, and by means of happy analogy and illustration has built up an atomic and molecular world in which his hearers, almost without realising the complexities with which they have to deal, are led from a molecule of hydrogen to those of methane and of benzene and, in a very little time, are finding structures such as that of tri-olein no more difficult to handle than that of ethyl alcohol

The story of the X-ray analysis which has unfolded the crystalline structure of fibres is one of the most fascinating of the tales that applied science has to tell, and the story loses none of its fascination in the skilled hands of Mr Astbury It is clearly and authoritatively told by one who has played a large part in its development. The titles of his successive lectures—the fundamental nature of matter and radiation , the invisible fibres of the world of molecules , how atoms and molecules make patterns in space ; an X-ray view of the inside of a textile fibre , the fundamental structural difference between wool and other fibres ; and some inside information about the properties of the wool fibre—show sufficiently well the lines along which Mr Astbury has developed his thesis

The textile students of Cleckheaton are to be congratulated on their privilege of hearing these lectures which, in their present form, should appeal to a very wide audience.

ALLAN FERGUSON.

Compression-Ignition Engines

High Speed Diesel Engines, with Special Reference to Automobile and Aircraft Types an Elementary Textbook for Engineers, Students and Operators By Arthur W. Judge Pp viii+248+35 plates (London Chapman and Hall, Ltd, 1933) 10*s* 6*d* net

MR JUDGE set himself a difficult task when he decided to compress into less than 250 pages an account of high-speed Diesel engines, which (as he hopes in the preface) will be equally suitable for engineers, students and operators The needs of the second and third of these groups, if not almost mutually exclusive, are at least difficult to harmonise the operator must think chiefly of details whilst the student's essential need is to grasp general principles and view the subject as an articulated whole Nonetheless, the author has achieved his aim in a remarkable degree, and no one who professes, or desires to profess, a close acquaintanceship with this type of engine can afford to ignore Mr Judge's contribution The title chosen for the book may be questioned, though the author makes some defence of his choice in urging that the name Diesel engine is more readily recognisable than compression-ignition engine There we think he is wrong, the latter name is already well enough known to those for whom he writes even if not to the world of the "Press and General Public" to suit which his choice of title was, he admits, mainly selected

One of the chief uses of this engine is found in road transport In the sixteen different makes on the road there are very varying standards of performance, but it is understood that more than one hundred motor vehicles using one of these engines are now on the road in London alone, and any criticism of their performance arises not because of failure in thermodynamic efficiency but mainly because, owing to the youthfulness of design, maintenance troubles loom rather large.

Another important field is that of aviation Here the great potential gains are the lessening of fire risk on crash, and the elimination of radio interference from ignition gear Both of these are of first-rate importance and the former can scarcely be over-emphasised, especially for civil air transport

On p. 196, the author gives an illustration of the rather complex Jumo engine which is a triumph of the illustrator's art · the credit for this he gives to our contemporary, the *Mechanical World* The illustrating work throughout is of a high level, and we think the author is to be congratulated upon the care he has taken to attain a high level in this regard Furthermore, his book gives the best short account we have seen of the various cylinder combustion-heads which have been tried, and of the important aim and purpose which lies behind them We have no hesitation in recommending this book as a valuable addition to any engineer's library

Problems in Mental Deficiency

Stoke Park Monographs on Mental Deficiency and other Problems of the Human Brain and Mind No 1 *The Burden Memorial Volume* Dedicated to the Memory of the late Rev Harold Nelson Burden Edited on behalf of the Medical and Consultant Staff of Stoke Park Colony, Stapleton, Bristol, by Dr Richard J A Berry Pp xix+249+29 plates (London Macmillan and Co, Ltd, 1933) 10*s* 6*d* net

IN this volume there is collected together a series of papers, dealing with the problems of mental deficiency, by a variety of authors, most of whom are members of the medical staff of Stoke Park Colony Two thirds of the articles have been previously published though they appear in this collection in slightly modified form

The first paper, which is the longest in the series, concerns the detection of potential 'social inefficiency' by physical and mental measurements, and was originally published in 1920 It contains a comprehensive table giving norms of the brain capacity of Australian children, calculated by one of Lee's formulæ The writer of the article, Prof R J A Berry, holds that there is a fairly constant relationship between head volume and intelligence, and he applies this hypothesis to the diagnosis of mental subnormality. He attributes the relatively small size of the heads of some delinquent and defective children to the incomplete development of the cerebral cortex The proportion of mentally subnormal individuals who have head measurements which do not deviate significantly from the normal is not indicated and without this knowledge it is difficult to see how cranial capacity can be of much diagnostic importance in a given case. The diagram shown on p. 26, apparently showing the relationship between mental age and cranial capacity, is misleading The correlation between these two variates is weak and many mental defectives of imbecile and idiot grades have heads of normal dimensions

One of the new papers gives a detailed analysis of cellular changes found in the brains of three defectives It is concluded that the more severe the grade of defect, the more disorganised is the histological picture of the cerebral cortex Another original article, by R M Norman, seeks to demonstrate a relationship between these cellular deficiencies in the cortex and neurological abnormalities which are to be found among mentally defective patients

In a short paper, published for the first time, R. M Bates describes three rare developmental abnormalities which have been found in association with mental retardation. This article is particularly good and it is well illustrated. It records a case of anomalous cervical vertebræ, a case of bilateral facial palsy with club-feet and an example of what is clearly acrocephalosyndactyly

Though there are many statements in this book concerning which research workers in mental deficiency and related problems will disagree, they will find it convenient to have the essays collected in a single and well-printed volume

Short Reviews

Edwardian England A D 1901–1910 a Series of Lectures delivered at King's College, University of London, during the Session 1932–3 Edited by Prof F. J C Hearnshaw. Pp 285 (London Ernest Benn, Ltd , 1933) 10*s* 6*d* net.

THIS book contains the latest of the well-known series of public lectures arranged by the History Department of King's College, London. "Edwardian England" may be said to include the first decade of the century, but there would be only a verbal incorrectness in extending it to the outbreak of the War. Edward VII's two main interests were society and foreign policy With regard to these two aspects of public life in England, there really was an Edwardian period But the same remark can scarcely be made of, for example, literature and science

Still, as Prof. H. Levy shows, in his illuminating lecture on the advance of science during the period, any link in the chain may be isolated for special study He rightly insists that it was appropriate in this lecture to regard science, not merely in an abstract sense, but also as permeating the social life of the time. It was the Edwardian period, for example, which saw the transition from dimly to brilliantly lighted streets and buildings, with consequent changes, on a great scale, in the uses of leisure. Passing from the effects of applied science upon social practice, Prof Levy refers at some length to the experimental and theoretical investigations that were maturing during the period. Here, what he has to say about relativity seems to us as clear as any popular explanation that we have encountered Naturally Prof. Levy's references to biology are briefer, but he explains how during the Edwardian period evolutionary theory advanced from a qualitative to a quantitative and measurable stage Both in scope and in treatment the lecture is a fitting contribution to the volume in which it now appears.

Annals of the Royal Botanic Garden, Calcutta. Vol 13 · *Asiatic Palms—Corypheæ.* Posthumous Work by Dr Odoardo Beccari Revised and edited by Prof Ugolino Martelli Pp vii+356. 50 rupees, 75*s*. Plates Pp v+102 plates. 26 8 rupees, 40*s* 6*d* (Calcutta Bengal Secretariat Book Depot, 1931)

FEW groups of plants are more difficult to comprehend systematically than the palms, and this is mainly due to the bulkiness of adequate specimens causing them to be largely neglected by explorers, so that we welcome the continuation of this great work on Asiatic palms by the late Prof. O Beccari, published posthumously by Prof. U. Martelli No eastern botanist ever possessed the knowledge of Asiatic palms which Beccari in his travels in Malaya, one of the richest palm areas in the world, had accumulated The Corypheæ are especially interesting as they appear to be the oldest known group occurring in the Eocene, and almost the only palms found in temperate regions, the unique European palm *Chamærops* being one of them

Besides full descriptions of the Asiatic species, illustrated by photographs of specimens, the author has added a very useful list with localities and diagnoses of those of the New World, with anatomical drawings of flowers and fruits All that now remains of Beccari's manuscripts in the capable hands of Prof. Martelli and awaiting publication, are those dealing with the Arecineæ, for the Lepidocaryinæ and Borassineæ were published in the Calcutta *Annals* before Beccari's death and the Phœnicineæ (dates) in Malesia. With the publication of the remaining portion the whole work will stand for ever as a worthy monument to one of Italy's greatest botanists, and this we hope will be carried out by Prof Martelli, who is much to be congratulated on the work of revision and publication of the present volume.

H. N. R.

Marie Stopes: her Work and Play. By Aylmer Maude. Authorised edition. Pp 299+8 plates. (London: Peter Davies, Ltd, 1933) 8s. 6d. net.

DR. MARIE STOPES is a remarkable woman; and if she were unaware of the significance of her work and influence, Mr. Aylmer Maude's book could not fail to enlighten her. It is not given to many workers in the realm of science—natural or social—to have their biographies published during their lifetime; so that Dr. Marie Stopes is fortunate in this respect and also in her biographer, whose literary gifts enable him to present a pleasing portrait of his subject

Dr. Stopes's scientific work in palæobotany, the composition and structure of coal, and related subjects, belongs to the first rank and has both scientific interest and practical value The general public knows nothing of her eminence in these fields and associates her name only with the subjects of birth control and problems of sex. For the enlightened view now taken of these matters by most people, the chief thanks are due to Dr. Stopes, whose work marks a new epoch in the life of the community Mr Maude is evidently an ardent disciple of this pioneer of social hygiene and intelligent reproduction of the human species; and on this account we ought perhaps to overlook the exalted position in which he sometimes places her Several of the chapters might have been abridged with advantage, but on the whole the book is a faithful record of Dr Stopes's activities in many directions

Elements of Optical Mineralogy. an Introduction to Microscopic Petrography By Prof Alexander N Winchell Third edition. Part 2 *Descriptions of Minerals, with Special Reference to their Optic and Microscopic Characters.* Pp xviii+459 (New York· John Wiley and Sons, Inc.; London. Chapman and Hall, Ltd, 1933.) 37s 6d net.

THE general arrangement of the third edition of Pt 2 of Winchell's "Elements" remains broadly the same as in earlier editions. Advances in knowledge of the relations between the optical properties and chemical composition of crystals, especially those affecting the amphibole group, have been incorporated in the text.

An important change has, however, been made in the chapter on the silicates, which occupies more than half of the book. This large group of minerals has been re-classified, so far as is at present possible, on the basis of the results obtained in recent years from X-ray crystal analysis. This change-over, with its subordination of chemical composition to crystal structure, is of the greatest theoretical interest In effect it summarises the results of all the work done on the silicates in recent years.

This is an invaluable work for students and research workers in mineralogy and petrography, It is therefore unfortunate that the slight increase in size of the latest edition should be accompanied by so very considerable an increase in price.

The Official Year-Book of the Scientific and Learned Societies of Great Britain and Ireland· with a Record of Publications issued during Session 1932–1933. Compiled from Official Sources. Fiftieth Annual Issue Pp. viii+171. (London: Charles Griffin and Co, Ltd., 1933) 10s net

THE publishers of this Year-Book are to be congratulated on their enterprise, for the present year marks the jubilee of its issue There can be no question that the existence of such an annual volume has promoted the interests of science generally and of the societies with which it deals, by providing accurate details of the numerous scientific bodies in the British Isles The present issue is on the usual lines, the various societies are classified into 14 groups The officers, membership, dates of meetings, and publications of each society, institute, etc, are given, and in many cases further details, such as the objects of the society, are appended A good index, and a logical grouping of the societies make it quite easy to refer to any society. All information incorporated in the volume is compiled from official sources, it is, indeed, a work of ready reference, worthy of support by scientific societies.

Modern Theories of Development· an Introduction to Theoretical Biology By Ludwig von Bertalanffy Translated and adapted by J. H. Woodger Pp x+204 (London: Oxford University Press, 1933) 8s 6d net

THIS important introduction to theoretical embryology is well-known to all those interested in the subject The English translation and adaptation by Dr Woodger will make it available to a wider circle of readers. The author proposes as a solution to the crisis of present-day biology, the constitution of a purified science which would relate and explain the accumulated facts pertaining to the study of living organisms As a synthetic principle of this science, the author proposes an organismic theory which would aim at the establishment of the laws of biological systems based on experimental data and on the possible use of mathematical logic

Examination of McTaggart's Philosophy Vol. 1. By Dr C D. Broad Pp. lvi+460. (Cambridge: At the University Press, 1933) 21s net

ONE cannot do justice in a few sentences to this excellent commentary of McTaggart's philosophy. Not only is McTaggart himself a great philosophical mind, but Dr. Broad, his commentator, compels the attention of his readers whenever he writes about philosophy McTaggart's "Nature of Existence" is a difficult book to study. But its reading will perhaps become easier after perusal of the present commentary. With a wealth of detail and a great ingenuity of thought, Dr Broad shows us how McTaggart's analysis of existence and reality led him to the formulation of the principle of determining correspondence, and what masterly use he made of this principle in the explanation of metaphysical values. T G.

Fluorescence and Its Use as a Method of Testing and Analysis

By DR JULIUS GRANT

ONE of the results of the increasing popularity in recent years of so-called 'sun-ray' treatment has been the rapid development of improved methods of generating ultra-violet rays This has placed in the hands of the scientific worker very efficient sources of such radiation, and it is therefore not surprising that other uses of this region of the spectrum should have followed in the wake of the above developments One of the most interesting is the generation of a characteristic fluorescence in numerous substances, and this is now widely employed as a method of testing and analysis

The range of ultra-violet radiation is usually considered to extend from about 136 A to 4000 A, but the principal rays used for obtaining fluorescence effects are confined to wave-lengths between about 2500 A and 3700 A, and there is ample evidence that individual rays in this range are particularly effective Similar selectivity is, of course, well known in connexion with work on ultra-violet therapy and on the photochemical activity of ultra-violet light.

FIG 1 Fluorescence photograph of a forged document Arrows indicate original wording, which is not visible in daylight

GENERATION OF ULTRA-VIOLET LIGHT

Methods of generating ultra-violet light are fully treated in works on light-therapy, and it is necessary here only to indicate some of the special requirements of fluorescence analysis

Carbon and mercury arcs have both been used, but whilst the former is best adapted for fading tests on account of the similarity of its spectrum to that of sunlight, the latter has proved more popular where an intense ultra-violet radiation is required with a minimum of visible rays The character of the actual radiation emitted depends, however, on the type of lamp and on the working conditions As is well known, the principle of the method is the production of an electric arc in the mercury vapour produced between two heated mercury electrodes Mercury lamps vary considerably in design, some give a point-source and are particularly useful for spectroscopy and fluorescence microscopy, whilst others are designed to give a maximum luminous area The unstable open forms of U- or H-tubes have now largely been replaced by completely enclosed types, one of the latest of which takes the form of an ordinary electric-lighting bulb containing a globule of mercury and two tungsten electrodes which serve both to heat the mercury and to carry the arc

There are also rival claims between lamps operating in a vacuum and at atmospheric pressure The latter have a great advantage in that they can be opened and cleaned, but on the other hand, with the former there is less necessity for such cleaning, owing to the absence of air One well-known design consists of an evacuated quartz tube, with a reservoir of mercury at each end, into which protrude metallic leads connected to the electricity mains When the lamp is tilted, the mercury runs across the floor of the vessel and short-circuits the two leads, the heat so generated produces mercury vapour and the arc then strikes.

Such lamps were at one time expensive and deteriorated rapidly, but recent models are cheaper both to buy and to run, and can eventually be regenerated The changes which occur on ageing often produce alterations in the spectral distribution of the radiation, and if these are not controlled from time to time discordant fluorescence results may be obtained

During the last year or so, several 'lamps' which utilise the ultra-violet constituents of daylight have appeared. They are essentially darkened boxes fitted with a filter to remove visible rays, and are necessarily relatively inefficient However, they are portable and comparatively cheap, and for some purposes are adequate

TECHNIQUE

The lamp is usually housed in a box, provision being made for viewing objects either by reflected or transmitted light through a filter which removes visible rays, the brilliance of which would obviously mask any fluorescence Filters may be solutions of dyestuffs or coloured or coated glasses, and may be chosen so as to isolate almost any given range of wave-lengths; nickel oxide glass ('Wood's glass') is, however, the best for most purposes. As already indicated, it is important to keep a control over both the quality and quantity of the radiations, and here again there is a wide choice of methods, of which the photoelectric cell and the use of the selective photochemical action of the rays on certain chemical reactions are the most promising.

The procedure depends to a great degree on the nature of the sample. Useful information is often obtained if a little powder is blown on to moist filter-papers which have been treated with reagents, whilst solids in the mass are usually exposed on a fresh fracture which also may be spotted with reagents. Liquids are examined in non-fluorescent containers, preferably in open Petri dishes or in quartz test-tubes, and it is often an advantage with solutions to use a variety of solvents and dilutions. Capillary analysis, in which the 'zones' produced on a strip of filter paper suspended in the liquid or solution are examined in ultra-violet light, has proved very useful, notably in connexion with mixtures of alkaloids and dyes, and Danckwortt and Pfau[1] have even obtained semi-quantitative results in this way.

When, however, it is required to determine the composition of a mixture containing a fluorescent ingredient, the usual procedure is to match it against one of a series of known mixtures. The importance of working under strictly standardised conditions in all this work cannot be emphasised too strongly. The type of lamp, its age, the time which elapses after striking the arc, the filter, the temperature and humidity, etc., all determine the actual appearance of the fluorescence, and it is essential that each worker should evolve and adhere to his own conditions if apparent anomalies are to be avoided.

The use of fluorescent compounds as stains in microscopy and as indicators in titration work has greatly widened the range of application of the method. In the former case it is often possible to bring out fine details, for example, of plant structure, which are invisible in daylight, whilst the latter method may be used for coloured fluids, for example, for the titration of quinine[2] and of the acidity of wines, and for neutralisation titrations in extremely dilute solutions. Photographic methods require special technique and their applications are limited by the difficulty of reproducing colour effects. They are, however, greatly used in criminological and museum work, for example, to provide evidence of falsification of documents (Fig 1 is a photograph of a falsified document taken in ultra-violet light, in which the original writing is plainly visible, although not apparent in daylight).

APPLICATIONS

The applications of fluorescence are numerous and varied, and can only be briefly indicated here; they are discussed fully elsewhere[3].

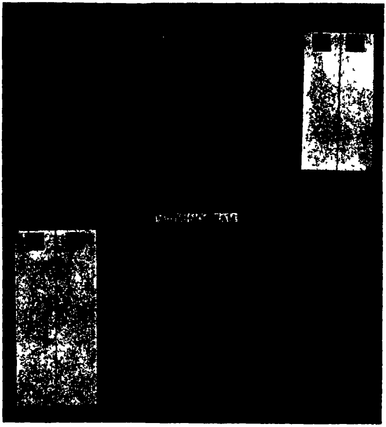

FIG 2 Comparison of daylight and fluorescence photographs of strips of yellow paper

The examination of chemical substances for purity is one of the best known. Many alkaloids, most dyestuffs and numerous inorganic and organic compounds give characteristic colours, and as these may depend on the origin, purity and method of manufacture, they form the basis of rapid testing methods, the importance of standardised conditions being always emphasised. Such methods have found application in connexion with paint pigments, drugs and all industries where dyestuffs are used. Thus in Fig 2 specimens 1–4 are strips of dyed yellow paper which appear identical in daylight (top row) but vary considerably in colour and in intensity in ultra-violet light (bottom row); Nos. 5 and 6 are the same as

No. 4 after exposure to sunlight (1 week) and to ultra-violet light (2 hours), respectively, and comparison of No. 7 with No 8 shows the effect of addition of wax size. Accelerated fading tests are best carried out with the carbon arc, which gives effects nearest to those of sunlight, in many cases the results from the mercury arc are definitely misleading and this lamp is more suitable for ageing tests, or for tests based on the use of the change in fluorescence on exposure (see Nos 5 and 6 in Fig 2) as a measure of stability

Plant materials offer a wide scope for the method, particularly if fluorescence microscopy is employed Examples are the differentiation of woods and of various strains of seeds, and the control of the composition of farm products such as fertilisers, poultry and cattle foods, dairy produce, etc Fig 3 shows the appearance in ultra-violet light of five rhubarbs (*R Palmatum*, High-dried Flats, Rough Rounds, *R Rhaponticum* and Canton, respectively), and is an example of the numerous applications of the method to plant drugs The fluorescence produced by bacteria, fungi, animal organs, sera and biological fluids also lends itself to the method, and a considerable amount of work has been carried out (notably by C Dhéré[4]) on blood and the porphyrins

FIG 3 Fluorescence photographs of five different rhubarbs

Closely related to this are applications to medico-legal work, particularly from the point of view of identifying stains on garments and drugs in body fluids, and although the method is in its infancy, it has already met with some encouraging successes

The method is also of considerable use in other branches of criminological work; erasures or alterations of written matter (see Fig 1) and the detection of imitation water-marks are examples, and in a case recently submitted to me[5], it was possible to differentiate easily between a genuine banknote and a particularly clever forgery from the fact that the dyestuff used to produce a blue design fluoresced with a green colour in one case but appeared black in the other.

Museum work should be mentioned in this connexion, since photographs in ultra-violet light of paintings, palimpsests and other documents frequently provide evidence of superimposition The dyestuffs used on postage stamps are excellent indications of possible imitations in philately, and a complete technique has been evolved for the examination of geological specimens and fossils. Since ageing influences the appearance of sculpture materials, ivory, woodwork, etc, repairs and imitations may be detected.

The application to work involving the use of organic solvents and mineral or essential oils is particularly wide, as such materials usually glow vividly in ultra-violet light Reference has already been made to the identification of dyestuffs and the use of fluorescent indicators, but it should also be mentioned that this work has provided useful information concerning the influence on fluorescence of chemical constitution.

In conclusion, the applications to the food industries merit a few words. Fatty foods fluoresce, the yellow colour of butter being modified by the presence of margarine or other foreign fats. A great deal of work has been carried out on milk, partly from the public health point of view and partly with the object of ascertaining the nature of the fluorescent constituent (lactochrome), which has now actually been isolated

The sensitiveness of micro-tests for organic or inorganic substances may often be magnified if the test involves the production of a compound which fluoresces, and several aids to the detection of preservatives such as boric, benzoic and salicylic acids, as well as sulphites[6], are provided in this way Other work has been directed to the examination of spices, cheese, jams and bakery and fermentation products, and among the confectionery products special mention should be made of honey[7], since applications of the methods of capillary analysis and absorption spectroscopy have yielded results which, it is claimed, enable a distinction to be made between honeys of different origins

No mention has been made of applications of the method to the rubber, cellulose, paint, fuel or ceramic industries, or to sewage disposal and general organic and inorganic analysis, but numerous applications suggest themselves, and the general utility of the method (provided always that working conditions are standardised) is now recognised

I am indebted to the British Hanovia Quartz Lamp Co, Ltd, for the loan of Fig 1, and to Messrs Chapman and Hall, Ltd, for Figs 2 and 3 (from "Fluorescence Analysis in Ultra-Violet Light") which were kindly photographed for me by Col W. R. Mansfield.

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[1] P W. Danckwortt and E. Pfau, *Analyst*, 52, 707; 1927.

[2] J Grant, *ibid*, 56, 653, 1931.

[3] J. A Radley and J. Grant, "Fluorescence Analysis in Ultra-Violet Light" (Chapman and Hall, Ltd., 1933)

[4] C. Dhéré and others, *C. R.*, 179, 351; 1924, 182, 321; 1926.

[5] J. Grant, *Analyst*, 58, 603, 1933.

[6] J. Grant and J. H. W. Booth, *ibid.*, 57, 514; 1932.

[7] G Orbán and J. Stitz, *Z. Unters. Lebensm.*, 56, 467; 1928

The Ray Society

THE recent appearance of the one hundred and twentieth volume of the publications of the Ray Society is a step onward in a great national undertaking. In the 'thirties of last century, the idea of producing a 'fauna' worthy of British science, in which every species of animal known to occur in Britain should be described and figured, with some account of its habits, habitat and synonymy, by the united labours of several naturalists, each an expert in his own line, was being realised under the sympathetic management of Mr Van Voorst. Yet in spite of the loving care that he lavished on the production, as is abundantly shown by the charming vignettes which adorn each chapter of his books, it became apparent to the naturalists who in 1843 attended the meeting of the British Association in Cork, that Van Voorst's series had begun with monographs which were 'best sellers', such as Bell's "British Quadrupeds" 1839, Yarrell's "British Fishes" 1836 and "Birds" 1843, and that there would remain a considerable residue of unmonographed classes of animals for which neither the British Association, nor the scientific societies, nor publishers would have the funds necessary for publication. "To rescue such precious materials from oblivion, is one of the objects for which the Ray Society was instituted."

The original proposal to found a "Ray Club", an association for publishing zoological and botanical monographs and translations "which would not be likely otherwise to find a publisher", was taken up by a considerable body of naturalists in response to a circular drawn up by George Johnston of Berwick-on-Tweed, and widely circulated by Sir William Jardine. Their replies are bound up in a volume of letters addressed to Sir William Jardine, recently presented to the Ray Society. Not all were enthusiastic. Botanists were on the whole inclined to the opinion that sufficient provision had already been made for the British flora, but Prof Charles Babington of Cambridge saw that in cryptogamic botany much remained to be done. Prof Richard Owen, quoting his experience of the early struggle of the Sydenham Society, at first refused to join the proposed club on the ground of the impossibility of getting enough members for the purpose. However, by dint of much correspondence, a sufficient body of subscribers was eventually secured, and on February 2, 1844, with a slight change of title, the "Ray Society" was instituted, and officers were elected, and on October 2, under the chairmanship of Sir Philip Egerton, the report of the first annual meeting was read by the secretary, Dr. Edwin Lankester. Four hundred members, including Prof. Owen, had been enrolled, £236 had been received in cash, and a programme of projected publications was issued; the first two being "Memorials of John Ray" and "Iconographia Linnæana or Illustrations of the original specimens in Zoology of Linnæus at present existing in the Museum of the Linnean Society", to be edited by Profs Bell and Forbes.

The second annual meeting was held at Cambridge on June 23, 1845, Prof John Phillips being in the chair.

Already in December 1843, "A Monograph of British Nudibranch Mollusca" was in preparation by Messrs Alder and Hancock; and a volume of "Reports on the Progress of Zoology and Botany" in 1841–42 was the first volume to be issued to the subscribers. Also the Council of the Society had plans for the translation of Aristotle on "Animals", Dioscorides on "Plants", Azara on the "Birds of Paraguay", and for a new edition of Linné's "Systema Naturæ".

None of these was attempted, though Johnston, who shared the secretarial duties with Dr Edwin Lankester, wrote: "I trust the Ray Society may publish a good translation of Aristotle and Pliny, but beyond these I hope we may have better fish to fry for a very long time to come." This hope has been most fully realised, for in its programme the Ray Society has gone from strength to strength.

The first great folio monograph to be undertaken was on the "British Nudibranch Mollusca". This continued to appear in parts for eleven years, and was completed by a supplementary volume fifty-five years later. Meanwhile, the high reputation of this folio series of monographs was firmly secured by the classic volumes of Allman on "Fresh-water Polyzoa" 1856, Huxley on "Oceanic Hydrozoa" 1859, Blackwell on "British Spiders" 1861–64, Carpenter on "Foraminifera" 1862, Gunther on "Reptiles of British India" 1864, Allman on "Gymnoblastic Hydroids" 1869–70, and McIntosh on "Nemerteans" 1873–74. They are not only scientific works of the first order, but also of artistic merit that had not been equalled.

The practice of publishing translations and reports on the progress of the biological sciences was discontinued after 1868. A high standard was also set in the series of octavo volumes. Charles Darwin's great "Monograph of Cirripedia" 1851–54, soon to be followed by Bowerbank's "British Spongiadæ" 1864, etc., put new life into the study of these groups. If we classify the various groups of organisms that have been monographed, we find them distributed as follows:

PROTOZOA: Foraminifera 1857, Rhizopoda 4 vols. 1905–18.

PORIFERA: by Bowerbank and Norman, 4 vols. 1864–79.

COELENTERATA: 1847, 1859, 1869–70; Sea Anemones 1927 and in continuation.

ANNELIDA: by McIntosh, Nemerteans, 1872–73; Polychæta, 1898–1921.

Fresh-water Polyzoa, by Allman 1856.

TRILOBITA: 1846.

CRUSTACEA: Entomostraca, 1849; Cirripedia, 1851–54, Copepoda, 1876–79; 1931–33; parasitic Copepoda, 1912–13.

ARACHNIDA: Oribatidæ, 1883–87, Tyroglyphidæ, 1901–3, Hydracarina, 1924–28.

INSECTA: Collembola and Thysanura, 1871; Aphides, 1875–82; Coccidæ, 1900–2, Orthoptera, 1919, Phytophagous Hymenoptera, 1881–92, Dragon-flies, 1930; Larvæ of Butterflies and Moths, 9 vols. 1885–99.

TUNICATA: 1904–12.

VERTEBRATA: Batrachia, 1896–97, Reptiles, 1863, Cetacea, 1866.

Among the botanical works are memoirs on Desmids, 1904–22, Diatoms, 1929; Charophyta, 1917–23, Lichens, 1851, and on Vegetable Teratology, 1868, 1915–6.

In the face of this successful record, it is now amusing to read a passage in one of Bowerbank's early letters to Jardine: "I have seen Owen this morning and find he is strongly opposed to us. I tried him very hard, but it was without effect. Never mind. His weight is not so great as you in the country may imagine, and I can see that we shall get on very well without him."

It is to be observed that although the majority of the volumes issued by the Society are concerned with the systematic description of the animals and plants of the British Isles, this was only one of the objects which the founders had in view, and from the first some of the publications had a wider scope. Some systematic monographs deal with Europe or India, or include the whole world in their survey, and there are occasional works on such subjects as morphology and teratology and on the historical and biographical aspects of the science.

When, as a boy, I stayed with my father at various country houses, I recall that frequent reference was made to the Ray volumes for the identification of unfamiliar forms of life. The library of a large country house would not have been considered as adequately furnished without these works of reference. Now, alas, owing to increasing specialisation, fewer and fewer people have time to be interested in the productions of their home-land, and it is therefore becoming more and more difficult to obtain support for scientific publications from individual subscribers. It has thus become the bounden duty of the public libraries to stimulate and provide for the public interest.

This account of the monumental achievement of the Ray Society must not be closed without some allusion to the fact that the earliest circulars and volumes issued by the Society in 1844 were printed by Messrs. C. and J. Adlard of Bartholomew Close, and that, although name and address have been modified, no other firm's imprint has appeared on the title pages for ninety years. Nor must we forget the very great services which have in recent years been rendered to the Society and to its authors by Dr. W. T. Calman in his editorial, no less than in his secretarial, capacity.

The agents for the sale of the Ray publications are Messrs. Dulau and Co. R. T. GUNTHER.

Obituary

PROF. T. SWALE VINCENT

DR. THOMAS SWALE VINCENT, formerly professor of physiology, University of London, died on December 31, 1933, at his home in Fishpool Street, St. Albans, at sixty-five years of age.

Born on May 24, 1868, the son of Mr. J. Vincent, Swale Vincent was educated at King Edward VI Grammar School, Birmingham, and took his medical course at the University of Birmingham, then Mason University College. After taking his degree, he went to the University of Heidelberg to study physiological chemistry under Prof. Kossel, and returned to Birmingham to take up his first appointment as demonstrator of physiology. The year 1894 had seen the birth of endocrinology as we know it to-day, with the discovery by Oliver and Sharpey-Schafer of the striking rise in blood pressure produced by the intravenous injection of an extract of the suprarenal capsules. Swale Vincent at once followed this new line of investigation, and pursued it through the whole length of his scientific career, with occasional excursions into the related fields of the circulation and of vaso-motor reflexes. In 1896 he published his first paper entitled "The Suprarenal Capsules in the Lower Vertebrates" in the *Proceedings of the Birmingham Natural History and Philosophical Society*. Soon afterwards he was appointed British Medical Association research scholar, and went to Sharpey-Schafer's laboratory at University College, London, where he continued his investigations. After two years he became Sharpey scholar in physiology, an appointment which carried with it the post of chief assistant in the physiology department, and later he was appointed assistant professor of physiology under Prof. Starling.

Swale Vincent left University College in 1900 to take up the post of lecturer in histology in the University of Cardiff. One of his students there was T. Lewis, now Sir Thomas Lewis, with whom he published two papers on the biochemistry of muscle. He left this post in 1902 to hold the Francis Mason research fellowship for investigating the physiology and pathology of the thymus and other ductless glands, and went to the Physiology Department of the University of Edinburgh which, under Sir Edward Sharpey-Schafer, had become an active centre of endocrinological investigations. He collaborated there with two advanced students, W. Cramer and W. A. Jolly, now professor of physiology at Cape Town. In 1904 he was appointed to the chair of physiology in the University of Manitoba, and remained in Winnipeg until 1920 He had to create an entirely new department there, a task which he performed so successfully that when he left Winnipeg to return to London as professor of physiology at the Middlesex Hospital, the University of Manitoba paid him a well-deserved tribute by conferring upon him an honorary LL D In London it again fell to his lot to reorganise the Department of Physiology, and its active scientific state when he retired in 1930 bears witness to the success of his efforts Swale Vincent was at various times examiner in the University of London and the University of Leeds, and also of the Conjoint Board. He had been secretary of the Ductless Glands Committee of the British Association since 1898 In Canada he served as a member of the Industrial Fatigue Board

Swale Vincent's numerous publications cover a large part of endocrinology. Beginning with a study of the suprarenal glands, he proceeded to investigations on the pituitary, the thymus, the thyroid and parathyroid glands, and the Islets of Langerhans He was a prominent representative of the Schafer school of physiology which, regarding the cell as a basic unit of physiological functions, combines histological studies with experimental technique The present generation of physiologists who can buy most of the various internal secretions in a more or less pure state at a chemist's shop, must find it difficult to realise the laborious investigations required to understand the morphological and functional relationships of the different parts of the endocrine organs, most of which are formed as a result of the joining up of histogenetically and functionally different tissues

In extending his investigations to the action of normal tissues other than endocrine organs, Swale Vincent discovered the existence of substances present in all tissues producing a marked lowering of blood pressure and different from choline One of these substances was identified later by Barger and Dale as histamine, the subsequent study of which in the hands of Dale and his collaborators has revealed its profound physiological significance. Swale Vincent was a careful worker, with a highly critical mind, qualities which enabled him to make positive contributions of lasting value, and to clear the new science of endocrinology from many pseudo-scientific weeds The high international reputation of his work found recognition in the request to write a series of reviews on the ductless glands for Ascher-Spiro's "Ergebnisse der Physiologie". These reviews were later expanded into a book "Internal Secretion and the Ductless Glands" which, first published in 1912 and since passed through three editions, is one of the standard works on the subject. He also published in 1924 an "Introduction to the Study of Secretion" and in 1929 with Prof. Sampson Wright, formerly his pupil and now his successor, "Introduction to Practical Mammalian Physiology".

Swale Vincent was a man of firm principles and high ideals on which he would not compromise. He was essentially a shy man, and this sometimes gave an impression of brusqueness, while to those who had the privilege of knowing him well he was a staunch friend and a charming companion He had a deep love and a great understanding of music and was himself no mean pianist. It was characteristic that in the last years of his active life he became interested in the study of the physiological reactions of the body to music. In 1914 he married Beatrice, daughter of Mr. W. Overton of London, who survives him, and had two daughters

W C.

Dr Knud Rasmussen

Knud Rasmussen, who died in Copenhagen in December last, devoted most of his life to the exploration of Greenland, particularly in regard to the ethnography of the Eskimo He was born in Greenland on June 7, 1879, the son of Chr Rasmussen, who was a pastor in that country and later a lecturer in the University of Copenhagen His mother was of Eskimo descent.

After taking his degree at Copenhagen, Rasmussen visited Lapland to study the natives and in 1902 returned to Greenland with M Erichsen to examine the social conditions of the Eskimo on the west coast. The report of that two years' study led to several reforms in the Danish system of administration, and in 1905 the Danish Government sent him again to Greenland to explore the conditions for reindeer as a source of livelihood for the natives From 1906 until 1909 he was in Greenland studying Eskimo folk-lore, and his visits to the isolated Polar Eskimo of the Cape Yuk area led to the foundation in 1909 of the mission station of Nordstjernen in North Star Bay The following year Rasmussen added a trading station and changed the name to Thule Afterwards the mission station was moved farther north, and Thule became the base for a long series of scientific expeditions under Rasmussen, in most of which he successfully used the Eskimo technique in travelling and hunting.

The first Thule expedition, in 1912, crossed the ice-sheet in the north-west to Danmark Fjord and Independence Fjord, thus linking the discoveries of Peary with those of Erichsen After spending some time in exploring around Thule and Melville Bay, Rasmussen led the second Thule expedition in 1916–18 to explore the topography and structure of the north-west coast. The return to Thule over the edge of the ice-sheet led to the death of the Swedish botanist, Th. Wulff, who succumbed to the hardships This expedition convinced Rasmussen that there can have been no migration of Eskimo round the north to the east coast of Greenland. Rasmussen did not take part in the third Thule expedition but devoted the fourth, in 1919, to a study of the folk-lore of the east coast Eskimo. The fifth Thule expedition, in 1921–24, entailed a journey, with K. Birket-Smith, from Greenland to Bering Strait through the whole extent of Eskimo territory with the view of studying the origin and evolution of

Eskimo culture. He found the oldest culture among the Caribou Eskimo, west of Hudson Bay. This spread to the arctic coasts and became dependent on marine animals, and then east and west until the Thule culture was homogeneous from Greenland to Alaska. An Alaskan culture, borrowing Asiatic influences, spread eastward as far as Greenland and is superimposed on the earlier culture. Rasmussen's researches on the Caribou Eskimo were a new chapter in ethnography.

With Denmark's increased attention to East Greenland subsequent to her suzerainty being established over the whole country, Rasmussen turned his attention to the east in the sixth Thule expedition of 1931. The aim was to explore the coast between Cape Farewell and Angmagssalik. Many additions to the charts were made and it was found that this part of the east coast is relatively free from ice in late summer. The seventh Thule expedition of 1932 was the largest that Rasmussen led. It was also the first on which he made aerial surveys. The work was the outcome of the previous year's reconnaissance and resulted in detailed surveys from Cape Farewell to Umivik, as well as two flights across the ice-sheet. Equally important was the archæological work on former Eskimo habitation of the coast. Rasmussen decided that seals were numerous enough to support a scattered Eskimo community. Hunters remained to investigate this problem more fully. It was from a resumption of this work that Rasmussen returned ill to Copenhagen last year.

Several of Rasmussen's works have been translated into English, including "The People of the Polar North" (1908), "Greenland by the Polar Sea" (1921) and "Across Arctic America" (1927). The reports of the various expeditions appeared in English and Danish in *Meddelelser om Gronland* and elsewhere. He also wrote several books in Danish including "Nye Mennesker" (1905), "Under Nordenvindens Svobe" (1906) and "Myter og Sagn fra Grönland" (1921–25). In all his works he had the happy faculty of combining a charming lucidity of style with a wealth of information. Among the many honours bestowed on Rasmussen were the Founder's Medal of the Royal Geographical Society, the Danish Medal of Merit and the orders of Dannebrog, St. Olav and the North Star.

R. N. R. B.

We regret to announce the following deaths:

Sir William Hardy, F.R.S., director of food investigation in the Department of Scientific and Industrial Research, secretary of the Royal Society in 1915–25, and president this year of the British Association, on January 23, aged sixty-nine years.

Dr F. L. Kitchin, F.R.S., palæontologist to H.M. Geological Survey of Great Britain, on January 20, aged sixty-three years.

News and Views

The Endless Adventure of Government

Problems of government and citizenship in the modern world were discussed by Mr Walter Elliot, the Minister of Agriculture, in his rectorial address as Rector of the University of Aberdeen on January 18. Government to-day, he said, is passing through a great transformation both at home and abroad. Governments and States are no longer merely geographical or political units, but economic units which every kind of intercourse has to take into consideration. Production is becoming decentralised; international trade less and less an interchange of specialised lines of production and more and more a competition in similar lines. The powers of modern science tend to make it feasible for specialised lines to be produced anywhere in the world, or to be replaced by others just as good; hence the national unit has become possible, although not necessarily desirable.

Interdependence of Various Countries

The formula of the continually increasing interdependence of the world requires qualification. Mr. Elliot gave three examples in illustration. In the first he traced the change in the economic aspect of the trade in nitrate for use as a fertiliser. In the nineteenth century a great trade was built up with South America; steel rails went out and nitrate came back. Large fortunes were made, international lending improved, and the economists were happy. But men of science, thinking it unnecessary to transport nitrogen to fields already supporting the pressure of a column composed mainly of that gas, found a means of producing it in Europe, which was good for production but bad for trade. Referring to the neon lamp, Mr. Elliot said it was the old lamp, and not the new, which demanded all the paraphernalia of nineteenth century economics; whilst the new artificial plastics derived from acetylene are replacing walnut and maple and the mahogany which took our forefathers to the West Indies. Mr. Elliot next turned to foreign investment, another section of the world's work where interdependence is no such certain sequence as was once assumed. A great deal of what is described as 'trade' is not exchange, but investment. The uneconomic nature of a great deal of foreign development has been masked by the free gift to competitors of transport systems, railway and steamer lines, which have been constructed at the expense of the producers in Great Britain and presented to their competitors.

Marketing Boards

The 'endless adventure of government, has become the problem of problems, the real riddle of the Sphinx. The reason is immediate fear—fear both of war and of peace. Organisation is essential; there are two methods—to organise the world at once, or to organise smaller units and gear them up to each other as soon as time and hard thinking will permit. Both methods are required. The States of the British Commonwealth of Nations have many economic problems in common, and the need of some standing organisation to examine these problems has been repeatedly felt. Mr. Bruce, formerly Prime Minister of Australia, has suggested that some of the best minds available should be applied exclusively to these formidable tasks, particularly in view of the emergence of British agriculture as one of the great and growing agricultures of the Empire. Mr. Elliot greatly hopes that the work will be undertaken. But an organisation which holds within itself the possibility of just such a development—the Empire Marketing Board—has within the last few months been brought to an end. The failure of some of these attempts, the difficulties of others, do not exonerate us from the necessity for making fresh trials. Let us try marketing boards to cover the United Kingdom if we cannot get one to govern the world, if we cannot get one to span the Empire. In agriculture we are working on the lines of self-government in industry. We are trying to reconcile the producers and the customers, the industrial and the political aspects of the nation, which can no more be separated than the front and the back of a man's head.

Another Large South African Diamond

A DIAMOND of fine quality was found in January by Jacobus Jonker in South Africa in the Elandsfontein alluvial diggings on a tributary of the Pienaars River, near the Premier diamond mine and north-east of Pretoria. The weight is given as 726 carats (145·2 gm.). There is no evidence to support the suggestion that this new 'Jonker' diamond is the missing portion of the 'Cullinan' diamond, which was found in 1905 in the yellow ground in the wall of the Premier mine at a depth of 18 ft. beneath the surface. The 'Cullinan' weighed 621·2 gm. (3106 metric carats), and, as shown by the large cleavage surface, it was evidently only a portion (perhaps rather more than half) of a larger crystal. Diamonds sometimes become fractured during the eruption of the kimberlite magma into the pipes. Other large stones, but of doubtful quality, have been recorded from the Premier mine, namely one of 1640 carats in 1912, another of 1500 carats in 1919, and another of 1195½ carats in 1924. The first of these weighings would be against the English carat of 205·304 mgm., and the last two presumably against the metric carat of 200 mgm. The next largest stone is the 'Excelsior' found in 1893 in the Jagersfontein mine in Orange Free State, which in the rough weighed 199·04 gm. With the older diamonds there still exists an unfortunate confusion in the weights when expressed in carats. The re-cut 'Koh-i-Noor', usually listed as 106$\frac{1}{16}$ carats, weighs 21·786 gm. or 108·93 metric carats. A mass of carbonado (a compact aggregate of small crystals of diamond) found in Bahia in 1895 weighed 630 gm.

Sir Hans Sloane's Collections

A TEMPORARY exhibit of a selection of minerals and botanical specimens and books from the Sloane collections is now displayed in a lighted case in the Central Hall of the Natural History Museum at South Kensington. It was these collections that formed the nucleus of the British Museum in 1753, and they contain many objects of considerable intrinsic value and of historic interest. A recent study of the voluminous MS. catalogues written by Sloane himself has led to the identification of many mineral specimens belonging to his collection. There is a good series of "pretious stones", including a magnificent Indian-cut sapphire weighing 31·5 carats, and a wonderful series of objects carved in agate, mocha-stone, carnelian, jasper, rock-crystal, nephrite, lapis-lazuli, etc. Most interesting are two drawers with the original labels from an old cabinet of minerals supposed to have medicinal virtues and listed as 'officinalis'. Sir Hans Sloane was a celebrated physician—it was he who certified the death of Queen Anne in 1714, and he succeeded Sir Isaac Newton as president of the Royal Society. One of the quaint entries in his MS. catalogue reads: "Lapis variolosus if hung about the Person makes the small Pox come favourable and hinders their being mark'd from its Signature". The Sloane collections were formerly in the old Manor House of Chelsea (built by Henry VIII), and his memory is preserved in a dozen streets, places, and squares named Hans or Sloane.

Indian Earthquake of January 15

A BRIEF notice of this great earthquake, based on the earliest reports, was inserted in our last issue (p. 94). Later accounts add considerably to the first estimates of the loss of life and of the extent of the disturbed area. It is clear that the number of deaths will amount to several thousand—in Monghyr alone, 4,000 are reported as killed. The epicentre, given by the seismographic records at Kew and Bombay, lies in lat. 26·8° N., long. 86·3° E., or a short distance to the east of the towns (Patna, Muzaffarpur, Monghyr, etc.) which suffered most from the earthquake. Thus, it would seem that the crust movement started a few miles east of Darbhanga and spread rapidly westwards for fifty miles or more. The distances from the epicentre of some of the places from which reports of the shock come are so great that it is only their close grouping that justifies their acceptance. Bombay is about 970 miles from the epicentre and Madras 980. Still farther to the south, and somewhat isolated, are Madura (1,250 miles) and Aloppey in Travancore (1,330 miles). If we assume the disturbed area to be bounded by a circle passing through Madras, it would contain three million square miles. The area included within the isoseismal of intensity 4 of the Kansu earthquake of December 16, 1920, was about 2½ million square miles, so that the area actually shaken must have been of the same order of magnitude as that disturbed by the recent earthquake.

Early History of the Reverberatory Furnace

AT a meeting of the Newcomen Society held on January 17, Mr. Rhys Jenkins read a paper on "The Reverberatory Furnace with Coal Fuel, 1612–1712". The term reverberatory, he said, came from the Low Latin "reverbero", to beat back; to-day, by reverberatory furnace, we mean one in which the material under treatment and the solid fuel are kept apart, and the flame and hot gases from the burning fuel enter the furnace proper at one end and are deflected or beaten down on to the material on the hearth by the roof of the furnace. The earliest account of such a furnace was given by Theophilus the monk, who wrote in the eleventh century. It was used for making glass. Early in the sixteenth century reverberatory furnaces were used in Germany for melting bronze for guns, but Agricola in his "De re metallica" makes no mention of them. The earliest description in the English language of a reverberatory furnace was found in a work published in 1613 by John Rovenson, while the earliest drawing of any value of a coal-burning reverberatory furnace was given by the German metallurgist Schluter in his "Grundlicher Unterricht von Huttenwerken" of 1738. During the seventeenth century the smelting of lead, copper and iron in reverberatory furnaces was attempted by various individuals at several places, the furnaces being generally without chimneys. An interesting point was when was it recognised that with a closed fireplace the air required for the combustion of the fuel could be drawn through by a chimney. The first record of the use of chimney draught is contained in Glauber's work of 1646 "Furni novi Philosophici", translated into English in 1651.

Petrie Portrait Fund

The retirement of Sir Flinders Petrie from the Edwards professorship of Egyptology at University College, London, has seemed to many of his friends an appropriate occasion for an expression of appreciation of his lifelong services to archæology. It is thought that this might most appropriately take the form of his portrait, to be presented to the College with which he has so long been associated. An appeal for funds for this purpose has been issued over the names of Prof. J. H. Breasted, M. J. Capart, Dr. Howard Carter, Prof. F. Ll. Griffith, Sir George Hill, Sir Henry Lyons, Dr. Allan Mawer, Sir Robert Mond and Dr. Margaret Murray. In issuing the appeal, it is pointed out that it is now more than fifty years since Sir Flinders began work as an archæologist at Stonehenge, and soon afterwards carried out the first accurate survey of the Pyramids at Gizeh. Referring to his influence on archæological studies during his long career as an excavator, the committee states no more than the bare truth when it points to his insistence on accurate observation and recording, and the stress he has laid on the significance of smaller finds, equally with the larger, in an excavation, in developing knowledge of the social conditions of the past. The appeal also refers to his early recognition of the importance of correlation in studying the intercourse between the various peoples of the Near East from earliest times. Finally, in attributing to him in large measure the awakening of modern interest in archæology, mention is made of the great number of archæologists who have achieved distinction after receiving their training and inspiration from him as lecturer and excavator. Subscriptions towards the fund will be received by Sir Henry Lyons, F.R.S., 3 York Terrace, Regent's Park, London, N.W.1.

Infra-Red Photography as an Aid to Navigation

The United States liner *Manhattan* has recently been fitted with a special look-out camera intended for an investigation of fog penetration with infra-red sensitive materials. Mechanism for the automatic developing and fixing of the photographs is included in the body of the camera itself, and the photographic record may be viewed one minute after the exposure has been made. The weather conditions encountered by the *Manhattan* since the new apparatus was installed have not been suitable for experimental work, so no records obtained under service conditions are yet available. The problem of fog penetration is not at all simple, and it remains to be seen whether the degree of penetration actually obtained by this method will be really helpful to navigators.

The Gases of the Atmosphere

In his presidential address before the Royal Meteorological Society at its annual general meeting on January 17, Prof. S. Chapman discussed "The Gases of the Atmosphere". The permanent gases of the atmosphere (mainly nitrogen and oxygen) are known, from direct measurements in the stratosphere, to be in constant proportions up to the greatest heights yet attained by Piccard and his successors in stratospheric flight. Other constituents vary in their concentration, because of processes tending to produce and destroy or transfer them in the atmosphere: among such constituents are water, ozone and the newly discovered positrons, which enter the atmosphere from outside as cosmic rays. Experiments were suggested to determine the rate of large-scale transfer of such gases by turbulence, using some easily detectable gas, artificially introduced, as an 'indicator'. Such experiments might also be made using ozone as the indicator, which would throw light on the distribution of ozone, as recently estimated by Dobson, Götz and Meetham. The possibility of removing the atmospheric ozone above certain ground areas was also considered. The absorption of solar radiation by oxygen and ozone was discussed in the light of new experimental data, and in relation to the composition and temperature of the upper atmosphere.

London's Underground Railways

By the formation of the London Passenger Transport Board last year, the unification of the underground train, bus, trolley-bus and tram systems of London has been accomplished. The British Electrical and Allied Manufacturers Association (Beama) has recently published a well-illustrated book giving an account of the part played by British manufacturers in providing machinery and equipment for this great transport service. The account given proves the sound administrative qualities of those who have made London's 'Underground' the foremost institution of its kind in the world. So far back as 1846, the prospectus which led to the foundation of the

Metropolitan Railway was issued, the object being to encircle the metropolis with a tunnel The scheme, of which Mr Charles Pearson, a city solicitor, was the author, was at first received with derision, and it was not until 1863 that the first section of the line, from Farringdon Street to Bishop's Road, was opened. The seven stations which formed this line have now increased to 226, and considerably more than a million passengers per day are carried Every weekday, 2,800 trains pass through Charing Cross station After forty years of steam, the Metropolitan and the District Railways were equipped for operation by electricity The great extension of London's underground railways and the equipment for electrical operation of the older steam lines was started in 1902 by the formation of the Undergound Electric Railways Co of London, Ltd., the site for the generating station being in Lots Road, Chelsea The great success of the undertaking is due to the recognition by the administration of the fact that the position is continually changing and that progress cannot be checked or thwarted in a living organisation

THE Lots Road Station is situated on the bank of the Thames at Chelsea and is well known to Londoners The amount of power generated per square foot of engine room area is six kilowatts, which is the highest figure for Great Britain The Neasden power station near Wembley Park supplies nearly 100,000 kilowatts, which is a third of that supplied by Lots Road The original plant was designed to operate with a steam pressure of 180 lb per sq in and a temperature of 550° F. , the present plant operates at a pressure of 265 lb. per sq in and 750° F. To supply the condensers with the necessary water, four artesian wells were sunk to depths varying between 400 ft and 600 ft and these yield about 18,000 gallons her hour After passing through the condensers, the water is cooled in wooden towers and utilised over again The electric transmission of energy is on the three-phase system at 11,000 volts, and many hundreds of miles of three core cable at this pressure are used The distribution voltage on the track is 630 direct current, the alternating current being converted to direct current either by rotary converters or mercury arc rectifiers The first escalator was installed at Earl's Court Station in 1911, and wherever escalators have been installed there has been a notable increase in the traffic In the event of any interruption to the train service, precautions are taken that there will be no delay in the issue of instructions to all sections concerned. At such points a loud speaker is installed and emergency messages are received from a central microphone in the control room at Leicester Square station

International Congress of Anthropology and Ethnology

ARRANGEMENTS are now well advanced for the first session of the International Congress of Anthropological and Ethnological Sciences, which will be held under royal patronage in London on July 30–August 4 next. The proposal to hold a congress of this nature was first made in 1912, when the International Congress of Americanists met in London, but the meeting in 1916, for which arrangements were then made, had to be postponed indefinitely owing to the War In future the Congress will be held every fourth year, alternating with the International Congress of Archæological and Proto-historic Sciences, which will be held in the second of the intervening years The Anthropological Congress will coincide with the meeting in Europe of the International Congress of Americanists, which this year is to be held at Seville The sessions of the Congress will be held at University College, Gower Street, and at the Wellcome Historical Medical Museum. The president is Lord Onslow and the chairman of the executive committee, Capt T A Joyce Prof J. L Myres and Mr A H. Brodrick are the joint honorary secretaries and Mr H G Beasley the treasurer Presidents of sections are Prof G Elliot Smith (Anatomy and Physical Anthropology), Mr F C. Bartlett (Psychology), Prof C B Fawcett (Demography), Dr. A C Haddon (Ethnography), the Rev. E. Smith, president of the Royal Anthropological Institute (Subsection of African Ethnography), Mr H Balfour (Technology), Prof C G. Seligman (Sociology), Prof E O James (Religions) and Dr. Alan H. Gardiner (Languages and Writing) Among the vice-presidents are the Archbishop of Canterbury, the Lord Mayor of London, the High Commissioners of India and South Africa, Sir James Frazer, and the presidents of the Societies of Antiquaries, the Folklore Society and the Royal Asiatic Society Particulars of the Congress may be obtained from the Royal Anthropological Institute, 52 Upper Bedford Place, W C 1

Archæology and Unemployment in the United States

IN the United States advantage is being taken of the funds available for the relief of unemployment to carry out certain archæological investigations which hitherto, although considered of great importance, have been regarded as too costly for the resources of the Smithsonian Institution, Washington The funds are to be provided by the Civil Works Administration and about one thousand men of the local unemployed will be engaged for the work of excavation. According to an announcement issued by the Smithsonian Institution, six Indian mound sites, each considered to be key positions in an archæologically unknown area, are to be explored In each case the work will be carried out under the direction of an official of the Bureau of American Ethnology. Three sites in Florida will be in charge of Mr Matthew W. Stirling, chief of the Bureau, one of these being an extensive system of pre-Seminole mounds and earthworks near Lake Okechobee which was discovered in 1931 , Dr F H H Roberts, Jr , will excavate a group of mounds in the Shiloh National Military Park at Pittsburg Landing, Tennessee , and Dr W F. Strong will be in charge of the exploration of a large mound six miles from Taft, Kern County, California, one of the key sites of Californian prehistory, which is known to have been abandoned soon after the first Spaniards reached the country At Macon, Georgia, a mound thought to be the site of an ancient Hitchi village will be explored. While deploring the circumstances which have made these undertakings possible, archæologists welcome the expenditure of funds in this direction, which, it is hoped, will at least make a beginning in putting the archæological exploration of the south-eastern States on the same systematic basis as the exploration of the south-west.

Coventry Libraries

THE Coventry Libraries and Museum Committee's report on the work of the year 1932–33 gives evidence of vigorous growth of the services under its care The Committee fosters the closest possible contact between the libraries and all activities of a cultural character, and is providing additional accommodation for such activities adjacent to its central library, where already during the past year meetings of societies devoted to the study of art, history, natural history, the drama, engineering, bee-keeping, etc, numbered 271, including 120 meetings of groups for the discussion of broadcast talks Among the most popular of the subjects of these discussions was "Biology and Everyday Life" Provision of books for children through the school library system, serving 55 schools and supplementing the activities of the special junior departments of the libraries, accounts for one sixth of the total issues Through the West Midlands Regional Library Bureau, the resources of many libraries in other parts of the country were drawn upon by way of temporary loans to meet special requisitions By the circulation of publicity material among branch libraries, the maintenance of a variety of book displays throughout the system was ensured Some of the most popular displays related to cooking, wireless, gardening, polar exploration, holiday literature, modern drama and home decoration. Among other services successfully maintained are the *Coventry Bookshelf*, a monthly medium of communication with readers; an "Illustrations Collection" of 15,000 pieces, a "lucigraph" for making facsimile copies of maps, prints, drawings, etc, a commercial and technical intelligence service, equipped with up to date indexes to practically all technical material published throughout the world, patent abridgments, consular and diplomatic reports, etc, and frequent exhibitions of material relating to matters of special local or regional importance.

Reform of Medical Education

IN his Bradshaw lecture recently delivered before the Royal College of Physicians, Dr C. S. Myers discusses the education of the medical student from the point of view of the industrial psychologist. As regards pre-medical study, which consists of physics, chemistry and biology, he considers that far more time is spent in practical work on such subjects than is necessary for those who are not going to specialise in any of them, especially as they have no educational value for the future doctor. A similar criticism is directed against the enormous amount of detail in anatomy and physiology required of the student, whereas little attempt is made at this stage to gather anatomical information from the corpse in the post-mortem room The student derives his knowledge of human anatomy mainly from dissection of the cadaver, in which the desiccated organs have lost their form and their relations in the living body. As a remedy for these and other defects in medical education, Dr Myers makes the following suggestions. In the first place, the student should spend part of his time in the wards as soon as he begins to study anatomy and physiology. Secondly, during the hospital period, he should receive a more complete education in the whole range of medicine and surgery before he attends the specialist departments. Thirdly, some training in the recognition and treatment of psychoneuroses is necessary for the future general practitioner, who is too liable to mistake the true nature of such conditions Lastly, before entering into general practice, he should serve an apprenticeship between the passing of the qualifying examination and the actual conferment of the diploma or degree.

Australian Meteorological Data

THE Council for Scientific and Industrial Research of the Commonwealth of Australia has published valuable meteorological statistics under the title "Meteorological Data for Certain Australian Localities" (Pamphlet No 42, Melbourne, 1933) A foreword explains that, for some time past, various investigators on the Council's staff had made extensive use of unpublished data collected by the Commonwealth Meteorological Bureau, in connexion with researches in soil science, entomology, plant industry, animal health, etc, and it was thought worth while to make such information more accessible to investigators by publishing selected data. The matter was discussed with the Meteorological Bureau, and it was agreed that the Bureau should provide the data and arrange the material in a form suitable for publication, while the Council would bear the costs of publication This pamphlet is the result of the co-operation of those two bodies. It gives in tabular form, for several hundred stations in Australia and Tasmania, mean monthly and annual values of daily maximum and minimum temperature and relative humidity, and average monthly and annual totals of rainfall. These averages refer to periods of varying length, as a rule not less than 15 years, and in not a few cases between 70 and 80 years. In the rare cases where the period is only five or six years, the figures may—especially in the case of such a variable quantity as rainfall—depart considerably from those that would be found over a suitably long period, but this drawback is nearly always met with in meteorological statistics for sparsely populated countries, and recourse must be had to such short records if large areas are not to be left unrepresented. A large folding map is attached at the end of the publication, which gives the meteorological divisions adopted by the Bureau and shows many of the stations included in the tables

Eugenics in Vera Cruz

IN December 1932 a new eugenic law was enacted in the State of Vera Cruz, which has the largest population in Mexico. A Bureau of Eugenics and Mental Hygiene was organised as a part of the

Health Department of the State. This Department has been engaged in eliminating smallpox and yellow fever, and has also greatly reduced the frequency of hook-worm, its sanitary services being in co-operation with the Mexican Government and the Rockefeller Foundation. The new Bureau is thus included in a public service and has large powers. Free birth control clinics were instituted, and sterilisation provided for in serious cases of unfitness and inadaptability. This is the culmination of a series of reforms made by Governor Tejada, which included the suppression of saloons, compulsory sex education in the schools, mandatory medical treatment for venereal disease and a new civil code which entailed eugenical provisions in matters of marriage and divorce. By the new regulations, which are given in full (*Amer. J. Psychiatry*, 13, No. 2) by Dr. S. Mendoza, who drafted the bill, provisions are made through the Bureau of Eugenics and Mental Hygiene not only for the dissemination of information but also for the control of sterilisation of persons suffering from hereditary diseases or from conditions which the Bureau considers to be "a cause of biological degeneration or mental deficiency in their offspring".

Association of American Geographers

THE thirtieth annual meeting of the Association of American Geographers was held on December 26-28, at North-western University, Evanston, Illinois. In the three day session fifty-seven papers were presented, including thirteen in the field of geomorphology, ten or more in regional geography and six in urban geography. The remainder represented a diversity of subjects. The afternoon of December 26 was devoted to the general subject of "Conventionalizing Geographic Investigation and Presentation". The papers on this subject were presented by Profs. P. E. James of the University of Michigan, Wellington D. Jones of the University of Chicago and V. C. Finch of the University of Wisconsin. A feature of the meeting was an address by Dr. L. Dudley Stamp, an invited guest of the Association, who spoke on "One Hundred Years of Change in Land Utilisation in the British Isles—the Work of the Land Utilisation Survey of Britain". The retiring president, François E. Matthes of the United States Geological Survey, gave the annual address. He spoke on "Our Greatest Mountain Range, the Sierra Nevada of California". The following officers were elected for 1934: *President*, Dr. W. W. Atwood, president of Clark University; *Vice-President*, Prof. V. C. Finch, chairman of the Department of Geography, University of Wisconsin; *Secretary*, Prof. F. E. Williams, University of Pennsylvania; *Treasurer*, Prof. R. S. Platt, University of Chicago.

Greenkeeping Research

THE autumn volume (No. 9) of the *Journal of the Board of Greenkeeping Research* contains a useful summary of experimental and practical results on the use of sulphate of ammonia and sulphate of iron as fertilisers and weed killers for lawns. It is interesting to note that the treatment has stood the test of several years' practical application, but its effects cannot be ascribed directly to increase in the acidity of the soil. Dr. F. T. Bennett describes a disease of turf known as *Fusarium* patch. The Director of the Board's Research Station at St. Ives, Bingley, Yorks, Mr. R. B. Dawson, contributes the fourth of a series of articles on "Common Weeds of Turf", whilst other members of the staff write on "A Greenkeeper's Guide to the Grasses" (Mr. I. G. Lewis) and "Composts and Fertilisers in Relation to Greenkeeping" (Dr. T. W. Evans). A new form of steriliser for killing weed seeds in compost which is to be applied to weed-free turf is described by Mr. K. M. A. Enthoven, of Hilversum, Holland. The subject matter of the whole volume is of great interest—almost a necessity—to golf green keepers, but the more general horticulturist will find a great deal of definite teaching which will help him to make his lawns the beautiful stretches of green sward which he so earnestly desires.

Scientific Horticulture

THE "Horticultural Education Association Year Book", vol. 2, 1933 has just appeared under the able editorship of Mr. R. T. Pearl (Wye, Kent: H. E. A., South-Eastern Agricultural College, 3*s.* 6*d.*). "Commercial Horticulture in Lincolnshire" is described by Messrs. J. G. Murray, F. Wakerley and J. C. Wallace, whilst Mr. D. V. Howells writes on the same topic for Scotland. Various aspects of fruit-growing are dealt with by Messrs. N. B. Bagenal, W. G. Kent, F. Kidd and C. West, B. S. Furneaux, R. Hart and A. J. Wooldridge. Dr. R. N. Salaman contributes a paper on potato virus diseases, Mr. C. A. Cameron Brown reviews early progress in electric soil heating, Dr. R. M. Woodman writes on weed killers, Mr. R. K. MacDowall on spraying with sulphuric acid, Mr. W. E. H. Hodson on chrysanthemum eelworm, and Mr. F. A. Secrett on "Early Market Garden Produce". Direct problems of teaching are discussed by Messrs. W. H. Christian and R. T. Pearl, whilst the presidential address by Mr. N. B. Bagenal is a biography of Thomas Andrew Knight. A valuable series of book reviews is added. The whole volume is a pleasing blend of science with practice.

Fossilised Tree Remains in Yellowstone National Park

SCIENCE SERVICE, Washington, D.C., has recorded an interesting discovery made during the construction of a new road from Tower Falls to Mammoth Hot Springs in Yellowstone National Park. While cutting through a rock, two petrified tree-stumps, both upright as they stood, the report says, millions of years ago, were brought to light. The progress of the new road has left the specimens cut in halves, embedded in the solid rock, which was probably volcanic dust when petrification was taking place during the Miocene period. It is even possible to trace the complicated root systems of the specimens. It has not been decided what species the remains represent. Chestnut, sycamores, sequoias, pines and cypress have all grown in this region during the centuries in which the fossilisation took place.

The Qattara Depression and Water Power

In a note in Nature of December 23, 1933, p 960, on Dr J Ball's paper in the *Geographical Journal* for October on the utilisation of the Qattara depression for water power, a misprint occurs in the estimate of distance that the power would need to be transmitted to the Nile delta This figure should be 150 miles, a distance over which water power could be readily transmitted, whereas the distance from the Aswan dam to the delta is 560 miles

Zoological Society of London

At the monthly general meeting of the Zoological Society of London held on January 17, it was stated that the total number of visitors to the Society's Gardens at Regent's Park for the year up to the end of December was 1,557,791. The number of visitors to the Aquarium during the same period was 263,438 At Whipsnade Park the number of visitors during the year was 433,429

The Night-Sky in February

Mercury reaches its greatest eastern elongation on February 18, when it will set an hour and ten minutes after the sun It is not easy to see this planet, but a sharp look out just after sunset in a situation where there is a good view of the western horizon may be rewarded. There will be no risk of confusion with Venus, which passes through inferior conjunction on February 5, and will not be visible in the evening sky after that date for several months, though it will be a brilliant object in the early morning sky just before sunrise. Mars is getting near the sun On February 18 it will set twenty-two minutes before Mercury, and will be practically invisible in the glare of the sunset Jupiter can be well seen in the early morning In February it will rise at about 10 p m. Saturn will be too near the sun for observation. It passes through conjunction on February 8.

Announcements

The Council of the South Wales Institute of Engineers has awarded the Institute's Gold Medal to Prof. A. E. Trueman, of the Department of Geology, University of Bristol, formerly of University College, Swansea, for his paper, "A Suggested Correlation of the Coal Measures of England and Wales", as being the most valuable paper received and published during 1933.

The Committee of the Cancer Hospital (Free), Fulham Road, London, has awarded a scholarship of the value of £100 per annum to Mrs Boyland in recognition of her services in the Research Institute of the Hospital She has investigated with Dr E Boyland the respiration of normal and cancerous tissues in the presence of derivatives of cancer producing compounds, and will continue the development of this work

The Secretary to the Minister of Health has announced that Sir Frederick Gowland Hopkins, Prof E. P Cathcart and Prof. Edward Mellanby, as physiologists representing the Minister's Advisory Committee on Nutrition, will confer with Prof. V H. Mottram, Prof S. J. Cowell and Mr G. P. Crowden, as physiologists representing the British Medical Association Committee on Nutrition, in regard to the differences which appear to exist between the two Committees on the question of the amount of calories and first-class protein appropriate as a basis for suitable diets

At the annual general meeting of the Royal Meteorological Society held on January 17 the following officers were elected for the ensuing year — *President*, Col Ernest Gold, *Vice-Presidents*, Mr David Brunt, Prof Sydney Chapman, Mr Francis Druce, Dr A Crichton Mitchell, *Treasurer*, Mr. R A Watson Watt, *Secretaries*, Dr J. Glasspoole, Mr W M Witchell, Mr. M McCallum Fairgrieve; *Foreign Secretary*, Capt C J P Cave, *New Councillors*, Dr A J Bamford, Mr M G Bennett, Mr I D Margary.

The following officers of the Royal Microscopical Society have recently been elected: *President*, Prof. W A F Balfour-Browne, *Vice-Presidents*, Mr J E Barnard, Mr Conrad Beck, Prof D M Blair, Dr G M Findlay, *Hon Treasurer*, Mr. C F Hill, *Hon Secretaries*, Prof R T Hewlett, J Smiles, *New Members of Council*, Dr A S Burgess, Dr R. S Clay, Prof R Ruggles Gates, Dr G S Sansom, *Hon Librarian*, Dr Clarence Tierney, *Hon Curator of Instruments*, Mr W E Watson Baker, *Joint Hon. Curators of Slides*, Mr N I Hendey, Mr. E J Sheppard.

Messrs Longmans, Green and Co, Ltd, hope to publish shortly the first of two supplementary volumes of Thorpe's "Dictionary of Applied Chemistry" This volume will contain subjects up to and including those coming under the letter M and the second will cover the remaining letters of the alphabet and include an index. The present editors, Profs J Thorpe and M A Whiteley, have preserved continuity and the traditional connexion of the "Dictionary" with the Royal College of Science.

Applications are invited for the following appointments, on or before the dates mentioned —A junior scientific officer in the Wood Chemistry Section of the Forest Products Research Laboratory, Princes Risborough, Buckinghamshire—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S W.1 (Jan. 29). A chief instructor in the Engineering Workshop of the Polytechnic, Regent Street, London, W 1—The Director of Education (Feb 5). A woman pharmaceutical chemist to the Gloucester County and City Mental Hospitals—The Medical Superintendent, County Mental Hospital, Gloucester (Feb 7). A junior engineer for the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, London, S W 1 (Feb. 10) A lecturer in physiology in the University of Leeds—The Registrar (Feb 19) A senior botanist in charge of the Cereal Sub-Section of the Botanical and Plant Breeding Section of the Ministry of Agriculture, Egypt—The Under-Secretary of State, Ministry of Agriculture, Cairo (March 15). A professor of economics at Raffles College, Singapore—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W C 1

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Activity of Crystalline Preparations of Vitamin B_1

IN the same laboratory where thirty years ago Eykman made his famous investigations, Jansen and Donath[1] succeeded in 1926 in obtaining for the first time the antineuritic vitamin in crystalline form, in quantities too small, however, for further study. Five years later, the same results were also obtained by other investigators; almost simultaneously there appeared publications on the same subject by van Veen[2], Windaus and Tschesche[3] and Ohdake[4], whose crystalline products were only slightly more active than that of Jansen and Donath, although at first the contrary was stated[5] Moreover, all these substances had roughly the same empirical formula, though they had been isolated from different sources —rice-bran and yeast.

This uniformity of results was broken by an announcement of Peters[6] and his collaborators, that they had isolated a still more active product. As a matter of fact, we were able to demonstrate in this laboratory that Peters' substance was about 1½ times as active as our purest product (and also Windaus's) The experiments were made with a kind of rice bird[7] These rice bird tests, which can only be made in Java (this being the one region where these birds occur), have the advantage that one works simultaneously with ten of these birds, which are very sensitive to a B_1 vitamin shortage and give very constant results Whereas about 0 5 mgm. of the original preparation of Jansen and Donath was needed to provide ten birds during about 25 days with the necessary B_1 vitamin (not a single case of polyneuritis occurring within 15 days), the necessary quantity of Windaus's and also of our preparation was 0 4 mgm., while of Peters' preparation only 0 3 mgm. was required.

By improvements of our method of isolation[8] applied thus far we have succeeded in isolating a crystalline product, which is about twice as active as our former preparation and then probably also more active than Peters' preparation; namely, 0 2 mgm sufficient for the rice bird test Of this preparation a rice bird therefore needs a daily dose of 0 8 γ, a young rat 1·5 γ or a little more. 1 gm. of this preparation is equal in activity to about 500,000 (provisional) international standard units The crystals are much flatter than those of the less pure preparations; the melting point is about 2° higher. Also its behaviour to different reagents is as described before[5]. The empirical formula is also similar to that of the less pure preparations from this laboratory (C, 40·7 per cent; H, 5 5 per cent; N, 15·7 per cent; it also contains sulphur). Hence it appears probable that the less active preparations contain inactivated vitamin, and the possibility is not excluded that even the most active preparations now obtained still contain inactive substance.

The 'activated clay' from this laboratory (which serves also as the League of Nations standard preparation) is a substance easily prepared in large quantities, and the isolation of the crystalline vitamin is a rapid process. In our opinion it is urgent that the investigation of this important vitamin should be made by numerous laboratories, in order to obtain definite results as soon as possible. We shall shortly publish elsewhere a detailed account of the improved technique for its isolation.

A G. VAN VEEN.

Medical Laboratory,
Chemical Department,
Batavia
Dec 6

[1] *Proc Acad Sci Amsterdam*, **29**, 1390, 1926
[2] *Recueil*, **49**, 1196, 1930
[3] *Z physiol Chem*, **204**, 123, 1932
[4] *Proc Imp. Acad Tokyo*, **7**, 102, 1931
[5] A G van Veen, *Z physiol Chem*, **208**, 125, 1932
[6] *Biochem J*, **27**, 232, 1933
[7] *Meded Dienst Volksgezondheid*, N I, **21**, 184, 1932
[8] *Recueil*, **50**, 610, 1931

The Unit Character in Genetics

IN his British Association address on "The General Nature of the Gene Concept"[1], Prof. R. Ruggles Gates states that "the conception of the unit character was given up many years ago". It is hard to let this fertile conception go without a word to be said for it, even though it may be ineffectual. If the conception of the unit character is not wholly true in its original connotation, it cannot be wholly false since man himself has been spoken of as a "rational animal", denoting an individual unit of the highest degree of complexity The cuticular bristles of arthropods are structures of their own kind, that is to say, they are homologous, whether transformed into tactile, olfactory, natatory setæ, supporting spines or prehensile hooks They may be regarded as units of the first order, although they possess such different potentialities, to which may be added the qualities of position, colour and size

In the district of Mille Isles, situated in a part of the province of Quebec where the Laurentian Hills begin to sink down to the level plain of the St. Lawrence basin, I have recently picked up from the snow a dipterous insect destitute of its two wings. There are several kinds of 'flies' to be found on snow in late autumn and early spring, but only one of them is wingless, namely, *Chionea* Through the kindness of Mr Arthur Gibson, Dominion Entomologist, I have been supplied with a list of Canadian records of *Chionea* These are few and far between, but they go back to the time of P. H. Gosse (1839) When seen moving with its long legs slowly and somewhat helplessly on the snow, it presents at a distance a spider-like appearance, and the species found in Germany was named *Chionea araneoides*. The wings have simply ceased to be, they have dropped out of existence at a plunge, but the balancers or 'halteres', which represent the hind-wings of the two-winged flies, are maintained in full working order. The wings of a fly behave as a unit, but they have many accessory characteristics, chief among them being the venation. Nevertheless the wings not only function as a unit but in *Chionea* they have also vanished as a unit, while the balancers remain in full force.

The finding of *Chionea* in the flesh is a rare experience not easily dismissed from the mind The lesson of it is the persistence of vestigial organs, when modified to serve a new function, after the normal organs of flight have disappeared without a trace. There are plenty of flightless female moths lying dead upon the snow at this season; before the snow sets in they are to be found clinging to the trunks of trees; some of them have rudimentary scaly wing-pads. There is a distinction to be drawn between mere loss of the power of flight, as in the female silkworm moth, reduction of wings, suppression of wings and phyletic loss of wings. But for the absence of its wings, *Chionea* is a normal dipteron with compound eyes and primitive segmentation of the body. As indicated above, the smallest units have a collective value and it is probably in the sense of absolute indivisible units that the conception of the unit character has been abandoned by geneticists.

A. WILLEY

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Dec. 5.

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[1] NATURE, 132, 768, Nov. 18, 1933.

IN my address on the gene concept, part of which appeared in NATURE of November 18, I was discussing the subject particularly from the cytological point of view. Prof. Willey, in his interesting letter, has in mind another aspect of the unit character conception which I consider is of great importance from a phylogenetical point of view. When I said that "the conception of the unit character was given up many years ago", I meant that the early conception of a strict one-to-one correspondence between a particular character and a particular factor or gene, is no longer tenable. Studies of the interactions of genes and the multiple effects of single genes in development of the organism show (1) that many genes may contribute to the final production of single characters, and (2) that single genes may have multiple effects in the organism. While these are now well known principles in genetics, nevertheless it remains true that each gene usually has a preponderating effect in the production of a single character.

Cases such as the wingless species, to which Prof. Willey refers, may be the result of single mutations, like some of the *Drosophila* mutations which are in a more or less completely wingless condition. The literature of systematic botany and zoology abounds with cases of a similar kind, where the natural interpretation is that a unit gene mutation has resulted in the sudden loss or marked change of a single character. The investigation of such cases opens up a vast field in which the systematists and geneticists could co-operate, but unfortunately until now comparatively little has been done in this direction.

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Variation du Rayonnement cosmique suivant la Latitude

LES études de la variation du rayonnement cosmique suivant la latitude (Clay, Compton et collaborateurs, Hoerlin) ont été effectuées jusqu'à présent avec la méthode des chambres d'ionisation; ces mesures ont montré l'existence d'un minimum de l'ionisation par rayons cosmiques dans les régions équatoriales.

Nous avons pensé qu'il serait bon de faire des mesures sous différentes latitudes, non de l'ionisation globale, mais du nombre de corpuscules pénétrants formant la partie directement décelable du rayonnement cosmique. Cette étude peut se faire avec des compteurs de Geiger-Müller montés en coïncidence.

Trois appareils, comportant chacun un dispositif de trois compteurs cylindriques superposés avec un sélecteur de coïncidences, un amplificateur et des relais, ont été emmenés dans un voyage Le Havre–Buenos-Aires et retour. Ils ont enregistré le passage des corpuscules ionisants pendant toute la durée du parcours, soit deux mois. Le nombre total de corpuscules enregistrés dépasse 100,000. Les résultats montrent une baisse régulière en fonction du temps que la comparaison des mesures à l'aller et au retour a montré être sensiblement linéaire; cette baisse due à une lente altération des appareils peut-être éliminée en faisant chaque fois la moyenne des mesures faites à l'aller et au retour aux mêmes points. On obtient ainsi les points figurés (Fig. 1) où les ordonnées représentent, à un facteur près, les nombres de particules traversant les compteurs en 1 heure, et les abscysses les latitudes des lieux d'observation. Les points marqués + sont relatifs à un appareil portant un filtre de 20 cm. de plomb. Les points marqués ○ sont relatifs à un appareil sans filtre, à compteurs proches. La courbe tracée présente un minimum dans la région de l'équateur. Le nombre de corpuscules pénétrants arrivant sur la terre à l'équateur est d'environ 15 pour cent inférieur à celui des corpuscules arrivant sous la latitude 40° (nord ou sud). Ceci est en concordance avec la diminution de l'ionisation globale observée, et montre que cette ionisation, qui peut-être due en partie à des rayonnements secondaires mous, suit bien le nombre de particules pénétrantes. Des mesures avec inter-

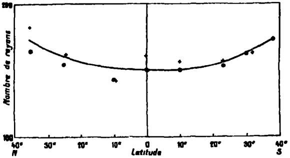

FIG. 1.

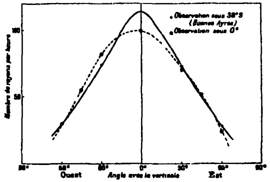

FIG. 2.

position entre les compteurs d'écrans absorbants (20 cm. de plomb) nous ont donné des nombres régulièrement inférieurs de 30 pour cent à ceux obtenus sans écran, la proportion relative de rayons très pénétrants restant donc sensiblement la même (au point de vue des rayons verticaux) sous toutes les latitudes explorées.

Nous avons également étudié la répartition angulaire des corpuscules cosmiques sous différentes latitudes, et trouvé que la symétrie entre les directions est et ouest que l'on observe sous les latitudes supérieures à 30° est détruite au voisinage de l'équateur en faveur des rayons venant de l'ouest, résultat qui est à rapprocher de ceux de Johnson.

La forme de la courbe est également assez différente, comme le montre le diagramme (Fig. 2), dans lequel sont portés les nombres de rayons arrivant sous différents angles à l'est et à l'ouest de la verticale.

La mission était subventionnée par la Caisse des Recherches Scientifiques. Nous désirons remercier la Compagnie des Chargeurs Réunis et l'équipage du vapeur *Kerguelen* qui ont beaucoup facilité notre tâche

PIERRE AUGER.

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Chemical Separation of Diplogen from Hydrogen

WE may reasonably anticipate that in those reactions which proceed at low temperatures, that is, reactions for which the energies of activation are small enough to render them sensitive to the difference in the zero point energies, diplogen and hydrogen will undergo reaction at different rates

We have found such a difference in the velocity of the liberation of hydrogen effected by the solution of metals in water or acids, for the liberated hydrogen does not possess an [H]/[D] ratio ([D] signifies the concentration of diplogen or the heavy hydrogen isotope) identical with that of the original water or acid. For example, on solution of zinc in 0·1 *N* sulphuric acid which contains 25 per cent D ([H]/[D] = 3), the hydrogen liberated contains only 8 per cent of D ([H]/[D] = 11·5), that is, the rates of production of H and D are in the ratio of about 4 . 1[1]. On solution of other metals similar differences are obtained, the approximate ratios for aluminium, calcium and sodium being 2, 1·5 and 1·2 respectively Analogous reactions in which compounds containing hydrogen, such as ammonia, acetylene, etc., are liberated instead of hydrogen, are now being investigated.

It appears possible that a reaction of this type, in which an enrichment of the heavy hydrogen isotope takes place as in the process of electrolysis, may serve as an alternative method for the production of heavy hydrogen and its compounds.

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L. FARKAS.

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Jan. 13.

For the method of analysis see NATURE, 132, 894, Dec. 9, 1933.

Measurement of the Frequency of Longitudinal Vibration of Non-Magnetic Rods

IT has been known for many years[1] that the resistance of a copper wire is increased by loading and that this increase of resistance is in excess of that which can be accounted for by the accompanying change of cross section. It seemed to be probable, therefore, that this phenomenon could be applied to the measurement of the frequency of longitudinal vibration of non-magnetic rods, since the method which has been described previously[2] cannot be used for such rods.

In order to test this possibility, a rod of the material was suspended in a long solenoid and clamped at the upper end A load was fixed at the lower end and the rod was connected in series with the solenoid winding, which was excited from a 30 volt battery of accumulators. Surrounding the rod near the central part of the solenoid was a search coil of about 20,000 turns, and this coil was connected through a valve amplifier to an oscillograph. The rod was then set in a state of longitudinal vibration by means of a slight tap on the lower clamp. In consequence of the corresponding variations of stress in the rod the resistance changed and the current in the solenoid varied accordingly. These variations of the exciting current induced corresponding E.M.F.'s in the search coil and the vibrations of the rod are thus recorded on the oscillogram The effect is small but definite and the results for two different rods are shown in Fig 1 *a* and *b*

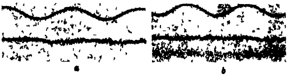

FIG 1

Fig 1*a* refers to a brass wire $\frac{1}{8}$ in diameter, the density being 8·4 and the free length 178 cm. The fundamental frequency of the vibrations as found from the oscillogram is 1030 cycles per second. For a rod clamped at both ends, the frequency *f* is related to the length *l* cm, the density ρ, and Young's modulus *E* by the expression

$$f = \frac{1}{2l}\sqrt{E/\rho} \text{ or, } E = f^2(2l)^2\rho \text{ dynes per sq. cm ,}$$

from which it is found that the value of *E* for a brass wire is 11·2 × 10^{11} dynes per sq. cm , or 16·3 × 10^6 lb. per sq. inch.

Fig. 1*b* refers to a rod of duralumin $\frac{1}{4}$ in diameter, the free length being 209 cm and the density 2·8. The fundamental frequency of longitudinal vibrations as found from the oscillogram is 1180 cycles per second, from which it follows that the value of *E* for a rod of duralumin is 6·8 × 10^{11} dynes per sq. cm., or 9·9 × 10^6 lb. per sq. inch

This investigation is being continued with the view of obtaining a larger amplitude for the wave due to the longitudinal vibrations. A higher frequency for the time calibration wave is also being used.

T. F. WALL.

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Dec. 9.

[1] Ency. Brit., 9th Ed., Vol. 8: Art. "Electricity", p. 52.
[2] NATURE, 132, 351, Sept. 2, 1933

Polarised Photoluminescence of Adsorbed Molecules of Dyes

I HAVE investigated the degree of polarisation of fluorescence and phosphorescence from 'Cellophane' films coloured by Kautsky's method[1] ('Cellophane' phosphors) The molecules of the dye, adsorbed on the surface of the microcrystals of the film, cannot rotate; therefore the luminescence cannot be depolarised by rotation

The films used, 0·09 mm in thickness, are optically anisotropic It is known that the orientations of the axis of the microcrystals are regular to a certain extent The observations were made with a Savart analyser and a set of compensating glass plates approximately in the direction of the exciting light, perpendicular to the surface of the 'Cellophane' phosphor. The latter could be rotated around this direction and the azimuth (α) could be read The analyser gave the value of $P = (I_1 - I_2)/(I_1 + I_2)$, where I_1 and I_2 are the intensity of the components the vibrations of which are parallel and perpendicular respectively to the direction of the vibrations of the exciting light transmitted through the polariser. When natural light was used for excitation, the same position of analyser was used

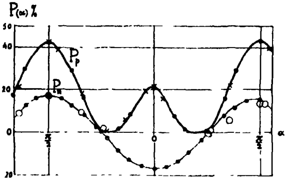

FIG 1 P as a function of azimuth (α) for euchrysine-'Cellophane'-phosphor
P_p, excitation with polarised light.
P_n, excitation with natural light
x and o observed values, ⊗ and ⊖ calculated values from the formulæ

$$P_p = \frac{(\epsilon_1^2 \cos^2 \alpha - \epsilon_2^2 \sin^2 \alpha) \cos 2\alpha - \cos^2 2\alpha}{\epsilon_1^2 \cos^2 \alpha + \epsilon_2^2 \sin^2 \alpha + 1} \quad \text{and}$$

$$P_n = \frac{(\epsilon_1^2 - \epsilon_2^2) \cos 2\alpha}{\epsilon_1^2 + \epsilon_2^2 + 2}$$

Fig 1 shows the $P(\alpha)$ curves for the fluorescence of a euchrysine 'Cellophane'-phosphor, for natural and polarised exciting light In the latter case, it is clear that the degree of polarisation for $\alpha = \pi/2$ is higher than for $\alpha = 0$ For those two azimuths, the exciting light vibrates to one or to the other principal direction of vibration in the 'Cellophane' film. Also when excited with natural light, the fluorescence shows partial polarisation in a certain direction (Fig 1, P_n)

Similar curves were obtained for phosphorescence but the values of $P(\alpha)$ were somewhat smaller.

Anisotropy was also examined by absorption, the absorption coefficients show an anisotropy, however. The position of the absorption band does not depend upon the direction of light vibration.

Although different dyes have $P(\alpha)$ curves of the same character, the values of $P(\alpha)$ differ very much. This indicates that the phenomena are not only due to the anisotropy of the field intensity of the exciting light (caused by the birefringence of the medium) but also to the polarisability tensor of the dye molecules and anisotropy of the distribution of the directions of their axes.

Details of this investigation will be shortly published elsewhere

A. JABŁOŃSKI.

Institute of Experimental Physics,
University of Warsaw.
Nov. 27

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[1] H Kautsky and A Hirsch, *Chem Ber*, 65, 401; 1932.

Predissociation in the Upper Level of the Ångström Bands of Carbon Monoxide

IN taking a photometer curve of the 0 → 1 band $^1\Sigma \rightarrow {}^1\Pi$ ($\lambda = 4835$), we observed that in all three branches, P, Q and R, beginning with the same value $J = 38$ of the upper level, the lines abruptly decrease in intensity to less than half the original value. It seems to us reasonable to assume that this remarkable feature is caused by a predissociation of $^1\Sigma$ into the triplet dissociation term ^3P (oxygen) $+ {}^1D$ (carbon)

Triplet-singlet intercombinations in the emission spectrum of CO have already been observed by Cameron. In this case the selection rule forbidding singlet-triplet transitions does not hold, but at any rate the Cameron bands are much more difficult to get than most of the other CO-bands, even though no other transition to a lower state of the molecule does exist. In the same way a predissociation of a singlet by a triplet term may occur As the transition to the dissociated molecule must be rather improbable, it seems that the life time of predissociation here becomes of the same order of magnitude as that which belongs to a transition with radiation In this case the emission lines do not disappear, but only decrease in intensity as has been observed A triplet-singlet intercombination with predissociation has also been observed by Herzberg[1] in the case of P_2 But for this much heavier element the probability of the triplet-singlet intercombination is already so large, that for P_2 the band lines totally disappear.

From the energy of the predissociation we were able to calculate the dissociation energy of the normal state We found $D = 9{\cdot}82$ volts, in good agreement with the value generally assumed (10 volts). For the other molecular terms we found as dissociation energies $A\ {}^1\Pi$, 1·82 volts; $B\ {}^1\Sigma$, 2·28 volts; $a\ {}^3\Pi$, 3·84 volts; $a'\ {}^3\Sigma$, 3·94 volts; $d\ {}^3\Pi$, 3·10 volts.

The upper zero vibration level of the Herzberg bands lies about 3100 cm.$^{-1}$ *higher* than the dissociation term $^3P + {}^1D$ Thus these bands from their beginning already suffer from predissociation and it is easy to understand why they are much more difficult to get than the Ångström bands.

Further particulars will be given shortly in the new Dutch periodical *Physica*

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F BRONS

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der Rijks-Universiteit,
Groningen.
Dec. 16

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[1] G. Herzberg, *Phys. Rev*, 40, 313, 1932

Effect of Pressure on High Terms of Alkaline Spectra

IN the alkaline spectra, very long absorption series have been observed. Wood and Fortrat have detected 56 terms of the Na, $3S-nP$ series. One might expect that the high terms of the series would be destroyed by adding a foreign gas, as the excited states of high quantum number have such a large volume that the number of molecules of the foreign gas contained in it can be, under experimental conditions, of the order of 10,000.

This argument proves to be untrue, as we have been able to observe the absorption series up to very high terms in sodium-nitrogen and sodium hydrogen mixtures with a pressure of the perturbing gas of the order of magnitude of an atmosphere.

With nitrogen as foreign gas, only a little broadening of the high terms, but no shift, was observed. Instead, in the case of hydrogen, all the high terms of the series are shifted by an approximately constant amount towards the violet. With a concentration of about $4 \cdot 8 \times 10^{19}$ molecules per c.c. of hydrogen, we observed a displacement of $7 \cdot 5$ cm^{-1} as is shown in Fig. 1. This shift is approximately proportional to the concentration of the perturbing gas.

One might attempt to explain this shift with the aid of the ordinary perturbation theory, considering some average potential for the electron over the very many potential holes, representing the foreign molecules contained inside the electronic eigenfunction. This would give a lowering of the high terms, and therefore a shift of the lines towards the red. However, Prof. Fermi has pointed out that this simple theory cannot be applied, as the first approximation of the perturbation theory is not sufficient for describing the phenomenon. His theory shows that the effect, though having the same order of magnitude as elementary theory, can be also of opposite sign, and explain a shift towards the violet as observed for hydrogen. The magnitude of the effect is connected with the limiting cross section of the perturbing molecules in the Ramsauer effect for zero velocity; the theory can also explain the fact that the high terms are not completely destroyed by the perturbation.

FIG. 1. Absorption spectra of sodium-hydrogen mixtures at higher pressures (above) and at lower pressures (below) of hydrogen. Note the unshifted mercury line 2537, which lies in the background.

An account of experiments with different gases and absorbing vapours will be published elsewhere.

E. AMALDI.
E. SEGRÈ.

Institute of Physics,
University,
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Dec. 2.

Graphical Determination of Contemporaries

LET points representing the years of birth and death of each of a group of individuals—for example, eminent men of science—be plotted with the year of birth as abscissa and the year of death as ordinate on the same scale. Each of these 'life-points' lies above the line $y=x$ since $y>x$, and, if 100 be taken for the limit of age, below the parallel $y=x+100$.

The dotted lines in Fig. 1 show two positions of a 45° set-square of transparent celluloid the hypotenuse of which slides along a straight-edge (not shown) parallel to $y=x$ and at such a distance from it that the apex is always on this line.

At the date given by the position of the apex on the line $y=x$, which may be called the time-line, any individual is not yet born if his life-point is to the right of the vertical edge, and dead if it is below the horizontal edge, while contemporaries are those whose life-points can be seen through the transparent set-square. The ages of these at the date are given by the distances of the points from the vertical edge, and also the ages at death of any of the group are given by the vertical distances of their life-points above the time-line, so that the life-points of all attaining the same age lie on a line parallel to it.

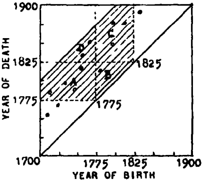

FIG. 1.

Suppose, as an example, that the group consists of thirteen individuals, all of whom are born and die between 1700 and 1900, and that their life-points are plotted as in Fig. 1. Then, placing the set-square with its apex at say 1775 on the time-line (the dotted lines show its position), it is seen at a glance that at this date two are dead, six contemporary, and five unborn. Similarly, at date 1825 seven are dead, five contemporary, and one unborn.

All whose life points are within the shaded area have lived at some time during the period 1775–1825. This area is composed of the parts A, B, C, D. Those with life-points in A were born before and died during the period, in B were born and died in the period, in C were born in and died after the period, and in D were born before and died after the period. When the period is sufficiently long the area D vanishes, and in such case none can be born before and die after the period.

When the number in the group is large the plotting of the life-points is laborious; but, this being done, complete information for any dates and any period can be obtained at once by mere inspection.

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Crouch End, N.8.

Parasitic Infection of Porcupine Fish

BETWEEN the first week in October and the middle of November last, thousands of dead porcupine fish, *Diodon maculatus*, were cast up on the south and west coasts of Ceylon. These dead fish were observed near Galle early in October; by the second week in November they were to be found in large numbers along a stretch of about two hundred miles of sea-coast from Hambantota to Chilaw. The fact that they were first found on the shores of the south-west corner of the island and later along the western coast seems to point to their having been brought in from the deeper waters to the south of the Gulf of Manaar, as their distribution corresponds with the prevailing direction of currents in October and in November

I examined a few of these fish collected at random. All of them were adults of about the same size and all were infested with a parasitic copepod which may be *Pennella sagitta*, the common parasite of *Diodon*. I cannot be definite with regard to this identification on account of lack of literature here and as this copepod differs in some respects from the description of *Pennella sagitta* taken from an *Antennarius marmoratus*[1]—the only description available. Some of the fish had but a single parasite, while others carried two or even three of them In addition, some had chalimus stages of a *Caligus* sp on them.

The cause of the death of this fish in such large numbers is difficult to ascertain Sudden alterations in the conditions of its habitat due to submarine disturbances can scarcely explain it Such disturbances would, no doubt, have affected other organisms living in the same habitat, but of this there has been no evidence whatever Could a plague of this *Pennella* have caused the destruction of such a multitude of these fish? *P. sagitta* is known as a parasite of several species of *Diodon* and *Antennarius* and the presence of one or two individuals does not, in ordinary circumstances, bring about the immediate death of the host Many of them on the same fish would endanger its life, but in this instance they were not present in such numbers as to justify the conclusion that they were solely responsible for this slaughter.

P. KIRTISINGHE.

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Colombo.
Dec. 5.

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[1] Leigh-Sharpe, W H, "The Genus *Pennella* as represented by the Collection in the British Museum", *Parasitology*, 20, 1928

Blood Composition in Relation to Milk Secretion

MANY attempts have been made to determine the changes in composition of the blood that occur in its passage through the mammary gland, with the view of elucidating the mode of secretion of milk. Earlier workers in the field (Meigs[1] 1922) thought that by examining blood taken from the jugular vein they were studying a fluid of similar composition to arterial blood, and undoubtedly the former can be obtained far more easily than the latter in the case of the bovine More recently, Blackwood and Stirling[2] (1932) have suggested that jugular venous blood is more concentrated than arterial, and they attribute this concentration to removal of water by the salivary glands.

Considering the small magnitude of the differences in blood composition which are under investigation in these studies, we feel that attention should be directed to the numerous grave sources of error which may be involved in obtaining blood samples, as in no instance reported in the literature have all of these been taken into account. These errors are fully discussed by Peters and Van Slyke[3] (1931) and the following examples need only to be mentioned, namely, changes in plasma concentration arising from venous stasis, such as may result from compression of the vein, use of oxalate as anticoagulant, undue exercise on the part of the animal or loss of carbon dioxide from the blood sample. In regard to the first point, we have observed such evidence of stasis as œdema in taking jugular samples, and it is a common practice to use means of compression in this procedure We are attempting to eliminate these sources of error from the work we have in progress, and hope to publish more detailed findings in the near future

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National Institute for
Research in Dairying,
Shinfield
Jan. 6.

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[1] Meigs, E B, *Physiol. Rev*, 2, 204, 1922

[2] Blackwood, J H, and Stirling, J D, *Biochem J*, 26, 357, 1932

[3] Peters, J P, and Van Slyke, D D, "Quantitative Clinical Chemistry", Vol 1 (Baillière, Tindall and Cox, 1931)

Catalytic Hydrogen Replacement and the Nature of Over-voltage

DR. J. A V. BUTLER has criticised our remark that the influence of the composition of the liquid phase on the catalysed reaction of hydrogen and water seems to prove that the rate-determining factor is the ionisation of the adsorbed hydrogen and not the preliminary dissociation of hydrogen into adsorbed atoms[1] Butler suggests that changes of the catalyst such as coagulation, may explain our observations Our communication as it stands is certainly open to this objection. We should have added, that in our experiment the greatest care has been taken to meet it, by ascertaining that all changes caused by the composition of the liquid phase are completely reversible. Twenty measurements were made on an identical sample of platinum black, all consistent with one another. Our platinum black was a quickly settling powder, it was shaken 15–20 times per second with an amplitude of 4–5 cm.

In these circumstances a structural change of the platinum black appeared to be an improbable explanation for which we could find no foundation in colloid chemistry. Our recent observations on the activation energy of the reaction, which will be soon reported, have confirmed our assumption.

J. HORIUTI.
M POLANYI.

University of Manchester.
Jan. 13.

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[1] NATURE, 133, Jan. 6, 1934.

Research Items

Acaxee of Ancient Mexico. The culture of a forgotten people of ancient Mexico, the Acaxee, is reconstructed from early records by Mr. Ralph L. Beals in *Ibero-Americana*, 6. The Acaxee, although now almost unknown to American ethnologists, once occupied a considerable area in the Mexican Sierra Madre, and remnants are said still to exist. Their culture presents many features unusual in North America. The term Acaxee is applied to a group of languages of the Uto-Aztecan linguistic stock, belonging to the Sonoran and not to the Mexicano-Nahua group. The Acaxee proper had their centre about the valleys of the San Andres and Topia. They differed from the lowland peoples in having a shorter stature and a yellowish-brown complexion. The Spaniards found them an admirable people, except for their persistent head-hunting and their extensive cannibalism. They were agriculturists and the chief features in their culture were warfare, head-hunting and the accompanying cannibalism, games, principally the footrace and the ball-game, and a strong agricultural-religious complex. It is possible that they lived in localised clan groups. It may be that their culture represents an intermediate link between, say, southern Mexico and the southern United States; but more probably it is the culture of a more or less stagnant area, a backwash surviving as a distorted reproduction of an earlier period in the history of Mexican culture.

Sunlight and Death of Snakes. Several notices have appeared in *Copeia* quoting well authenticated reports that rattlesnakes (*Crotalus confluentus*) are killed by short periods (about 10 minutes) of exposure to direct sunlight, and popular belief attributes similar susceptibility to the sidewinder (*Crotalus cerastes*). As a consequence, several observers have tested the reaction of snakes to sunlight with a variety of species, and the general result has been that, in full sunlight on sandy ground, the desert snakes have rapidly become uncomfortable, lost the power of co-ordinating movements and have died in 6–20 minutes. To discover the lethal factor, H. F. Blum and C. R. Spealman tested the light rays and came to the conclusion that no definite part of the spectrum was injurious to the rattlesnake, but that death was due to rise in body temperature owing to the combined effect of the absorption of solar radiation and conduction of heat from the ground surface (*Copeia*, 1933, p. 150). That this supposition came near the truth was shown by testing the reactions of snakes in a hot-air bath. Death resulted when the bath had reached a temperature of 49° C. It is significant that Walter Mosauer and E. L. Lazier found that in all the specimens they tested the body temperature at death was almost identical and was 46·5–47° C. (*Copeia*, 1933, p. 149).

Indian Polychætes. Prof. P. Fauvel has recently given a systematic account of the Polychæta of the Indian Museum, Calcutta (*Mem. Ind. Mus.*, 12; 1932); 306 species, belonging to 30 families, are recorded. The coastal region is, as might be expected, much richer in species than the deep sea, and among the examples from brackish water, modified and often peculiar forms are plentiful; one of them cannot apparently be referred to any known family. As is usual in tropical seas, the families best represented are the Aphroditidæ, Nereidæ and Eunicidæ. Twenty-eight new species are described. This polychæte fauna does not differ materially from that of the Red Sea, the Persian Gulf, the Philippines and the Malay region; many species from the Pacific and the Australian region are also found in the Indian area. Of the 306 species, 67 are also European and the author points out that it is becoming more fully recognised that many polychætes are really cosmopolitan. *Mercierella enigmatica*, first recorded from brackish waters near Caen and from the London docks, was believed to be an exotic polychæte brought home on the hulls of ships. In the collection now described, specimens of *Mercierella* were found adhering to oyster shells from the Ennur backwater, Madras, thus confirming the suspicion of its Indian origin. It was probably brought to London on ships' hulls and transported thence by coasting vessels to the French ports and estuaries from which it has been recorded.

The Frog's Tongue. As the result of a study of the tongue of *Rana hexadactyla*, C. P. Gnanamuthu (*Rec. Ind. Mus.*, 35; 1933) concludes that the movements of the frog's tongue are brought about entirely by muscles; Hartog's view, that extension of the tongue is due to lymph pressure, is untenable. He states that the submaxillaris muscle and the lymph spaces below the hyoid are not adapted to participate in the projection of the tongue. The tongue has two muscles—the hyoglossus and the genioglossus. The hyoglossus remains in a contracted or tonic state when the tongue is at rest and is relaxed when the tongue is pushed out of the mouth. The genioglossus, by which the front part of the tongue is attached to the symphysis of the lower jaw, is peculiarly modified; its dorsal part serves to reduce the length and breadth of the tongue while the ventral or basal part serves to give the anterior part of the tongue a forward pivotal movement.

Aerial and Soil Roots in *Acanthus* and Propagation from its Leaf. A. McMartin has recently published two papers (*Trans. and Proc. Bot. Soc. Edin.*, 31, Part 2, 1933), which deal mainly with the anatomy of the root system. He shows that the differences between air and soil roots must be traced in the main to factors at work in the growth of the apex. In the soil, growth in length is greater than in the air, but in the latter case there is more radial growth and, as a consequence, considerable development of a pith. The aerial roots in this genus have usually been described as 'prop' roots, but their mechanical structure is shown to have little relation to such a function and their presence is correlated with the inadequate radial growth proceeding in the stem, basipetal growth activity taking instead this form of aerial root development, which provides a further source of water supply to the leafy shoot. A second paper describes the origin of the root in leaf cuttings of *Acanthus* and the modification in structure of this root which follows as its proximal end tuberises and then develops buds. An analogy is drawn between the change in structure in this region and in the hypocotyl of the normal seedling.

Mosaic Disease of Raspberries. Mr. R. V. Harris has recently published the results of his investigations on the mosaic disease of raspberries ("Mosaic Disease of the Raspberry in Great Britain. I: Symptoms and Varietal Susceptibility". *J. Pomol and Hort. Sci*, 11, No 3, 237–255, Sept. 1933). The range of leaf symptoms is classified according to severity, as 'type a', 'type b' and 'type c', and the disease seems to be quite distinct from leaf-curl and from a peculiar chlorosis upon the variety Devon. A tentative classification of varieties according to their relative susceptibility is given, and evidence is collected to show that this virus disease becomes worse in certain districts.

Lower Gwanda Gold Belt. The geology of the Lower Gwanda Gold Belt, one of the lesser known inliers of the Basement Schists of Rhodesia, is described by Mr A E Phaup in Bulletin 24 of the Geological Survey of Southern Rhodesia (Salisbury, 1933, pp 74, with coloured geological map). The region is situated about 85 miles south of Bulawayo. As in some of the other gold belts, the Basement Schists are predominantly a series of metamorphosed basic lavas, some of which were limburgites, which must have reached an immense thickness, whatever allowance be made for folding. Sedimentary rocks, including banded ironstone, form only a small part of the lower division of the Series. Proof is given of two periods of granite intrusion and the mineralisation of the gold reefs is referred to the earlier granite. Up to the present, eight small gold mines have been productive, the chief being the Legion Mine, which has produced more than 22,000 oz. of gold. After pre-Cambrian times, denudation removed several miles of rock, before the injection of an easterly swarm of basaltic dykes, probably during late Karroo times. Since then only a few hundred feet of rock have been worn away to produce the present topography.

Climatology in Rhodesia and East Africa. One of the five sections into which the last of the five volumes of Köppen and Geiger's "Handbuch der Klimatologie" is subdivided is devoted to the climate of Rhodesia, Nyasaland and Portuguese East Africa. This section, which has recently been completed, can be obtained, like the other sections, as a separate publication (Berlin: Gebruder Borntraeger. 6 marks) in English. The authors are C L Robertson, chief engineer, Irrigation Division, and N. P Sellick, meteorologist, of Salisbury, Southern Rhodesia. Before proceeding to the general and detailed descriptions of the climates of these countries a short history of their meteorological services is given. From this can be gathered an idea of the difficulties encountered in dealing climatologically with these areas, arising from the fact that until recent times there has been little co-ordination of the observations made by private individuals, on which a detailed knowledge of climate, and especially of rainfall, ultimately depends. There is nothing in this work calling for special notice, the handling of the available statistics being on orthodox lines. Attention is directed at an early stage to the great influence on the weather exerted by the high altitude—3,000 feet or more—of a large proportion of South Africa. The lofty plateau profoundly modifies the movements of the high and low pressure systems appropriate to these low latitudes, and this has, of course, large meteorological consequences; moreover, the influence on temperature of the mere elevation underlies all the seasonal and casual variations of the weather, and mitigates the unpleasantness of some of the climatic features.

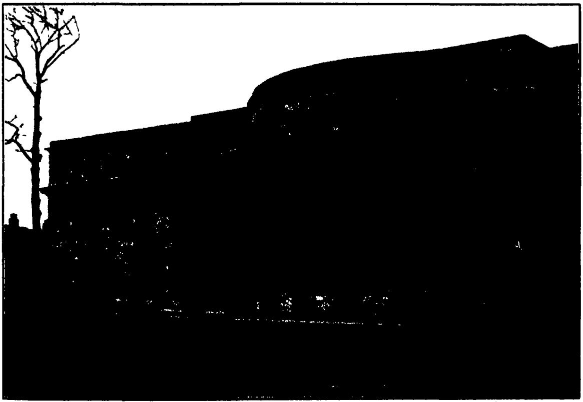
Cold Emission from Liquid Mercury. It has been established that electrons may be pulled out of metal surfaces by a sufficiently large electric field. The quantitative study of this effect is hampered by the uncertainty in the field due to minute roughness of the metal surface. Beams (*Phys. Rev*, Nov. 15) has attempted to study the emission from a liquid mercury surface, which must be free from such roughness. An added interest is in the probable part played by auto-electronic emission in the cathode spot of the mercury arc. In the experiments the mercury pool was cooled by a freezing mixture to keep down the vapour pressure, and an impulsive potential was applied to a spherical steel anode placed just above the mercury surface. Since the potential was applied only for a few microseconds, the mercury surface was not distorted by the electrostatic forces. A rotating mirror photograph shows that the luminous discharge starts at the anode, presumably as a result of bombardment by the electrons drawn from the cathode. The experiments showed that with a clean mercury surface the discharge was initiated by a well-defined field of about $1\cdot8 \times 10^6$ volts per cm. This value is much lower than predicted by the theory of Fowler and Nordheim. Taking the work function of liquid mercury derived from photoelectric experiments (4·53 volts) the theory predicts a field current of less than one electron per second, which could not possibly start a discharge. This discrepancy may be due to the submicroscopic structure of the surface—the author is going to undertake measurements of the photoelectric threshold and autoelectric breakdown at the same mercury surfaces. The magnitude of the autoelectronic threshold indicates that this electron emission may be important in the mercury arc.

Effects of Sun on Radio Transmission. By sending radio impulses to the outer regions of the earth's atmosphere, far above the stratosphere and unreachable by balloons or aeroplanes, physicists have obtained evidence that regular variations in radio echoes are due to the effect of ultra-violet light from the sun. Irregularities in the radio echoes show, however, that they are affected by other causes. In a paper read on December 22 to the American Physical Society, Drs. H R. Mimno and P H. Wang, of Harvard University, discussed the results obtained by using automatic apparatus for 6,000 hours last year. According to Science Service, they pointed out that changes in the electric conductivity of the ionosphere, which extends far above the stratosphere, affect our daily life. Most auroral displays occur at great heights and are accompanied by violent magnetic storms which interfere with telegraph and cable communication. Less violent disturbances may have the effect either of improving or of interrupting radio reception. Long distance trans-oceanic radio communication would not be possible if these atmospheric electric charges were not dense enough to deviate the radio wave and turn it back towards the ground. Even at short distances 'reflected waves' produce 'fading' in broadcast reception, 'ghost images' in television and are responsible for the slow alterations in signal strength noticed after nightfall. Radio transmission is affected by the 11-year sunspot cycle. Substantial progress has been made by physicists in finding out the nature and cause of these continual changes by using radio apparatus merely as a tool in their measurements.

New Chemistry Building of the University of Leeds

SIR FREDERICK GOWLAND HOPKINS formally opened the new building for the Department of Chemistry at the University of Leeds on January 12 (see NATURE, Jan 20, p 95)

The major portion of the new building consists of two wings extending at right angles to the frontage in Woodhouse Lane The shorter or north wing, with its large semi-circular window and pillars of Portland stone, forms a conspicuous external feature, it contains the lecture rooms, large-scale laboratory, workshop, private rooms for the staff, common room, library, and a number of small research laboratories The south wing, which is built of red brick and is not visible from the main road, contains the large teaching laboratories with their service rooms and store rooms. The front section, which faces east on to Woodhouse Lane and connects the north and south wings, contains a number of laboratories for advanced and post-graduate work as well as rooms devoted to the study of special branches of chemistry. The building consists of three floors above ground and a basement extending under the south and east block The ground floor is devoted mainly to inorganic chemistry, organic chemistry occupying the first floor and physical chemistry the second floor All three sections share the lecture rooms, large-scale laboratory, library and the basement, where work requiring freedom from rapid temperature changes and vibration can be carried out. The total floor space in the whole building is about 72,000 sq ft The architects are Messrs. Lanchester and Lodge, of London



Photo] [*Sport and General*

FIG 1 North wing of the new Chemistry Building of the University of Leeds

At the present time the total number of students working in the Department is about 380 undergraduates, including an honours school of approximately fifty, and a research group of from ten to fifteen

The general arrangement of rooms is best considered in relation to the teaching laboratories in the south wing On the ground floor are two inorganic laboratories, each of a floor area of 3,400 sq ft and containing together 144 working places, and a smaller one in the entrance block for more advanced work with 24 places These serve to accommodate the large number of elementary students taking a one year's course, as well as those studying inorganic chemistry as part of a final or special honours subject. The large laboratories each contain twelve bench units of six working places, affording a 5 ft length of space for every student. Each bench unit contains twelve lockers

The gas, water and electrical services run between the girders across the laboratories and are laid under the benches in concrete channels, which also serve to carry the stoneware water pipes from the sinks Accessibility to the channels has been ensured by having the locker cupboards in movable units which can easily be withdrawn. In addition to the usual services, each working place is provided with its own draught flue which fulfils the double function of removing noxious fumes and of ventilating the rooms. The flues, which are constructed of cement asbestos, join up with trunking below the bench level but above the waste channels, and run into ducts of the same material carried in vertical chases in the side walls, to the exhaust fans on the roof of the building. These vertical chases also carry the waste pipes and services and are easy of access for repairs. This principle applies also to all the laboratories in this wing. Situated between the two large laboratories and conveniently arranged are the apparatus store, acid store and steward's office, as well as rooms for furnaces, sulphuretted hydrogen, distilled water, and other necessary adjuncts. In the entrance block, besides the honours laboratory there are a gas analysis room and a balance room, and immediately below the latter in the basement is a small spectroscopic room for teaching purposes.

Research accommodation for the staff of the inorganic section is afforded by a group of small laboratories situated in the north wing. The equipment is simple in character and designed to ensure easy adaptation for carrying out work demanding special apparatus. Ledges with services and movable tables form a special feature of the fittings, and by means of a large duct for services running above the main corridors, it is easy to introduce special types of installation or to modify the existing services (gas, electricity, water or compressed air) as occasion may demand. Amongst this group of rooms is situated the departmental library, containing a valuable collection of chemical journals and treatises from the library of the late A. Chaston Chapman, generously presented to the Department by Mrs. Chaston Chapman in memory of her husband. The basement rooms are also of the same type and designed for post-graduate research. Those under the main entrance are without windows and completely below ground, and have proved to be singularly free from earth tremors and vibration.

The building is heated throughout by radiators supplied with hot water from the University boiler house. Compressed air for laboratories and lecture rooms is supplied from a small compressor in the basement.

On the organic floor the arrangement of teaching laboratories, main stores and accessory rooms is similar but modified to meet the requirements of this branch. Unlike the ground floor, the two large laboratories are provided with island benches, twelve in number, and will accommodate a total of ninety-six students.

Along the east and north wings are distributed five research laboratories for the staff and post-graduate workers, in addition to the professor's private accommodation.

Every laboratory is fully equipped as to services, which include compressed air and direct as well as alternating current. Hooded stone benches for combustions are provided in both teaching and research laboratories, and the space below the fume chambers is utilised for iron-shuttered bomb cupboards. Every island bench has power plugs for stirring motors, and a noteworthy feature is the supply of steam to enamelled iron baths on every working bench in the teaching laboratories as well as to suitable points in the research rooms.

Special attention has been given to the provision of adequate and effective fume chambers. These, both in the research and teaching laboratories, are of large size and lined with Sindanyo material which is specially resistant to the action of organic solvents as well as to acid steam. Gas, water and steam taps can be controlled from outside each chamber. The draught is taken from openings at the top and bottom of the chamber which lead into vertical ducts in the walls to exhaust fans on the roof. The air flow is approximately 500 cubic feet per minute for each chamber. It can thus be claimed that the traditional unpleasantness of organic operations has been largely eliminated. The general lay-out and detailed planning of this floor was mainly the work of Prof. C. K. Ingold, now professor of organic chemistry at University College, London.

The laboratories on the second floor are planned and equipped with a view to the special requirements of teaching and research in physical chemistry. The laboratory benches are to a large extent of the island type without super-structures, and are thus adapted for experimental work with physical apparatus. Particular attention has been given to the electrical services, which provide for the supply of A.C. current from the mains, D.C. current (50–75 volts) from a motor-generator and also constant voltage current from a large storage battery which is connected up with the lecture rooms as well as with all the laboratories on this floor. Extreme variations in temperature have been guarded against by a special form of insulating ceiling.

The accommodation available includes a large general teaching laboratory fitted with fireproof thermostat and side-benches in addition to twelve island benches which provide working places for 48 students. In close proximity to this are, as on the lower floor, a number of smaller accessory rooms—balance room, fume-cupboard room, special apparatus room, store rooms and cloak rooms as well as a drawing office and staff common room.

A special laboratory on the north side is devoted to electrochemistry and experimental work involving the use of heavy currents of electricity. Optical work may be carried out in dark rooms situated partly on the second floor and partly in the basement. Other rooms on the north and east sides of the building are designed for use as special research rooms or for experimental work which cannot be carried out in the main laboratory. The second large laboratory on this floor is set apart to provide for the special needs of medical, dental and pharmaceutical students in physical and organic chemistry.

The lecture theatre accommodation is situated in the north wing, and students have direct access to it without passing through the rest of the building. It consists of two large theatres, seating 250 and 144 respectively, and one much smaller room accommodating 40. The large theatres are specially equipped for experimental lectures; the lecture benches carry all services, and are fitted with draught flues. The natural lighting is from above and can be cut off by a sliding panel operated electrically by the lecturer, who can vary the artificial lighting by a dimmer switch. Special ventilating fans draw in air from behind the heating radiators and exhaust it through the roof, and a wall lining of acoustic board has proved very successful in securing good acoustic properties. The largest theatre occupies the upper part of the semi-circular frontage facing up Woodhouse Lane, and it is noteworthy that no traffic noises are audible inside. The lecture preparation room is conveniently situated between the two large theatres, with a gallery for the manipulation of the diagram screens and a chemical museum on the floor below.

Prize Awards of the Paris Academy of Sciences

AT the annual public meeting of the Academy of Sciences, held on December 11, the prizes and grants awarded in 1933 were announced as follows:

Mathematics.—The Francœur prize to Paul Mentré for his work on geometry.

Mechanics.—A Montyon prize to René Thiry, for his work on the mechanics of fluids; the Poncelet prize to Eugène Bertrand de Fontviolant, for his works on mechanics; the Boileau prize to Adrien Foch, for his works on hydraulics; the Pierson-Perrin prize to Paul Langevin, for his work on the mechanical applications of piezo-electric quartz.

Astronomy.—The Lalande prize to Georges Prévost for his tables of spherical functions and their integrals; the Benjamin Valz prize to Henri Labrouste for his methods of research on periods in solar phenomena; the G. de Pontécoulant prize to David Belorizky, for his work in celestial mechanics; the Antoinette Janssen foundation to Daniel Chalonge for his studies in astronomical physics.

Geography.—The Gay prize to Alphonse Berget, for his treatise on oceanography; the Alexandre Givry prize to the late Pierre Gerson, for his hydrographic work.

Navigation.—The Prix de la Marine between Gaston Dollé and Henri Dutilleul (4,000 francs) for their work on autogenous electric welding and Jean Fieux (2,000 francs) for his applications of the gyroscope to navigation; the Plumey prize between André Grebel (1,500 francs) for his study of combustion in internal combustion motors, the late Paul Leroux (1,500 francs) for his experiments in hydraulics, and Gérard Delanghe (1,000 francs) for his work on Diesel motors.

Physics.—The Gaston Planté prize to Lucien Jumau, for the whole of his work on accumulators; the Hébert prize to Pierre Fleury, for his work on photometric standards; the Henri de Parville prize to Louis Leprince-Ringuet, for his work on atomic physics; the Hughes prize to Salomon Rosenblum, for his work on the α-rays; the Paul Marguerite de la Charlonie prize to Amédée Guillet, for the whole of his scientific work.

Chemistry.—The Montyon prize (Unhealthy Trades) to Georges Darzens, for his work in connexion with the control of petrol storage; Paul Émile Thomas receives an honourable mention for his researches on carbon monoxide and nitrous vapours; the Jecker prize between Mme Pauline Ramart-Lucas (5,000 francs), *for her studies on the relations between the* properties of molecules and their absorption spectra, Émile André (2,500 francs), for his studies on fats, and Raymond Delaby (2,500 francs), for the whole of his work in organic chemistry; the Cahours prize to Georges Allard, for his work on the electronic structure of the ethylene carbon atom and on metallic borides; the Berthelot prize to Henri Moureu, for the whole of his synthetic work in organic chemistry; the Houzeau prize to Paul Laffitte, for his studies on explosives.

Mineralogy and Geology.—The Cuvier prize to Jules Lambert, for the whole of his work on the Echinidæ; the Delesse prize to Christopher Gaudefroy, for his work in physical crystallography; the Victor Raulin prize to Jean Cuvillier, for his work on the Egyptian Nummulitic; the Joseph Labbé prize to Pierre Despujols, for his studies on the mineral resources of Morocco.

Botany.—The Desmazières prize to René Vandendries, for his work on the sexuality of the Basidiomycetes; the Montagne prize to Roger Heim, for his work in mycology; the de Coincy prize to Louis Emberger, for the whole of his work.

Rural Economy.—The Bigot de Morogues prize to Serge Winogradsky, for the whole of his work on the microbiology of the soil.

Anatomy and Zoology.—The Da Gama Machado prize to Jean Verne, for his memoirs on pigments in living beings; the Savigny prize to Georges Sénevet, for his work on the blood sucking arthropods of Algeria and the Mediterranean basin.

Medicine and Surgery.—Montyon prizes to Charles Cot (2,500 francs), for his work on asphyxia, Paul Durand (2,500 francs), for his researches on pustular fever, Jean Lereboullet (2,500 francs), for his memoir on the tumours of the fourth ventricle; honourable mentions (1,500 francs) to J. A. Lièvre, for his book on parathyroidal osteosis, Adolphe Zimmern and J. A. Chavany, for their book on electro-radiological diagnosis and therapeutics of diseases of the nervous system, Henri Velu, for his book on "Dermes"; a citation to Nguyên-Van-Khai, for his memoir on the study of the prophylaxy of cholera by anti-cholera vaccination; the Barbier prize to Augustin Boutaric, for his researches on the properties of colloids and their relations with various biological phenomena; the Bréant prize to Georges Le Dentu, Adolphe Sicé and Marcel Vaucel, for their work on the therapeutics of human trypanosomiasis; the Godard prize to Henry Blanc, for his book on the phenolsulphonephthalein test in urinary surgery; the Mège prize to Edgard Zunz for his book on the elements of general pharmacodynamy; the Bellion prize to Mme. Lucie Randoin, for her work on vitamins; the Baron Larrey prize to Félix Pasteur, for his work on the utilisation of sunlight in the Sahara for the heating and purification of water.

Physiology.—The Montyon prize to Jean Gautrelet, for his book on the elements of physiological technique; the Pourat prize to Jean Chaze, for his biological work on the tobacco alkaloids; the Philipeaux prize to Pierre Dussumier de Fonbrune, for his memoir on a new micromanipulator and arrangement for the manufacture of micro-instruments; the Fanny Emden prize between Herbert H. Jasper (2,000 francs), for his psychological and physiological study of right and left handedness and ambidexterity, and Mme. Andrée Courtois-Drilhon, for her book on biochemical studies on the metamorphosis of the Lepidoptera.

Statistics.—The Montyon prize to Charles Marie, for his work in connexion with the annual tables of constants and numerical data of chemistry, physics, biology and technology.

History and Philosophy of Science.—The Binoux prize to Louis Pasteur-Vallery-Radot, for his work in connexion with the publication of the "Œuvres de Pasteur".

Works of Science.—The Henri de Parville prize to Gustave Juvet for his book on the structure of the new physical theories.

Medals.—Berthelot medals were awarded to Georges Darzens, Mme. Pauline Ramart-Lucas, Raymond Delaby, Henri Moureu and Paul Laffitte.

General Prizes.—The Grand prize of the physical sciences to Clodomir Houard, for the whole of his work, the Bordin prize to Szolem Mandelbrojt, for his memoir on the unicity of Fourier's series, the Lallemand prize to Alexandre Monnier, for his work on the physico chemical mechanism of nerve action; the Petit d'Ormoy prize (Mathematical Sciences) to Arnaud Denjoy, for the whole of his mathematical work and in natural science to Louis Léger, for the whole of his work on theoretical and applied zoology, the Estrade-Delcros prize to Ernest Vessiot, for the whole of his scientific work, the Le Conte prize to Eugène Bataillon, for his work on experimental parthenogenesis, the Parkin prize to René Hazard, for his work on the pharmacology of the alkaloids, the Saintour prize to Georges Giraud, for his work on partial differential equations and integral equations, the Lonchampt prize to Edmond Voisenet, for his work on the production of bitterness in wine and on the Adamkiewicz reaction, the Wilde prize to Mme Irène Joliot Curie and Frédéric Joliot, for their experimental work establishing the existence of neutrons, the Gustave Roux prize to Maurice Collignon, for his palæontological work on the Madagascan fauna, the Charles Dupin prize to Bertrand Gambier, for his work on geometry, the Marquet prize to Alexandre Bigot, for his work on the geology of Normandy

Special Foundations—The Lannelongue foundation to Mmes Gabriel Cusco and Raphaël Ruck

Prizes of the Grandes Ecoles—The Laplace prize to Maurice Allais, the L E Rivot prize to Maurice Allais, Raymond Fischesser, Robert Paoli and Max Dumas

Funds for Scientific Researches—The Gegner foundation to Valerian Agafonoff, for his researches on French soils, the Hirn foundation to Paul Ditisheim, for his work on chronometry, the Henri Becquerel foundation to Ludovic Driencourt, for his work on navigation and geographical maps

Loutreuil Foundation

1 *Researches on Fixed Questions*—Jean Basset (4,000 francs), for researches on the pathogeny and immunisation in anthrax, Charles Lombard (3,000 francs), for experimental researches on the pathogeny of cirrhosis, Pierre Pons (3,500 francs), for researches on wool products from central and southern France, James Basset (5,000 francs), for his studies on the influence of high pressures on physical and chemical phenomena, Jean Dufay and Daniel Chalonge (5,000 francs), for chemical and spectrographic researches on the atmosphere carried out at the Observatories at the Jungfraujoch and at Interlaken; André Charriou, for his researches on the latent photographic image, Paul Henri Fleuret, for his studies of the mechanism of the formation of ketonic and oxalic acids, Laboratoire central d'électricité (12,000 francs), for making the standard of inductance with a view to the measurement in absolute value of the unit of electrical resistance, Charles Marie (3,000 francs), for systematic researches in electrochemistry; Henry Pollet (2,000 francs), for his studies of atmospheric electricity during dust winds in north China

2 *Researches to be carried out in the French Colonies*—Henri Humbert (15,000 francs), as a contribution to the cost of an expedition to Madagascar and southern Africa with a view to the study of various types of vegetation and their variations under the influence of the nature of the soil, altitude and climate; Louis Dubertret (7,000 francs), as a contribution to an exploration of the volcanic desert region to the south-east of Damascus, Jean Piveteau (4,500 francs), to contribute to the cost of excavations in a deposit of vertebrates at Oranais

3 *Purchase of Laboratory Material*—Ecole nationale vétérinaire de Lyon (6,000 francs), for the purchase of a Phillips' portable apparatus for radiography and radioscopy, Léon Huillet (3,000 francs), for the purchase of a Chevenard temperature regulator, Jules Lemoine (2,000 francs), for the purchase of a microphone designed for the study of internal friction in metals, Henri Chaumat (2,000 francs), for the purchase of material for the construction of an electrostatic machine, Maurice Javillier (3,000 francs), for the purchase of an incubator, Raymond Ricard (3,000 francs), for the purchase of a Fabry and Pérot interference standard

4 *Libraries*—The following grants are given to libraries for the purchase of books. Ecole polytechnique (7,000 francs), Ecole national vétérinaire d'Alfort (10,000 francs), Ecole national vétérinaire de Toulouse (2,000 francs), Ecole supérieure de Chimie de Mulhouse (2,000 francs), Société française des Electriciens (1,500 francs), for the purchase of "Faraday's Diary"

Publications—Archives de zoologie expérimentale (10,000 francs), for assisting the publication of a jubilee volume; Bibliothèque national et universitaire de Strasbourg (5,000 francs), as a contribution to the publication of the catalogue of scientific periodicals, Emile Mathias (4,000 francs), for the publication of two memoirs dealing with the action of lightning on man and animals.

Mme. Victor Noury Foundation

Norbert Casteret (2,000 francs), for his hydrological and speleological explorations in the Pyrenees, Mlle Madeleine Friant (2,000 francs), for her book on the dentition of mammals, Josué Hoffet (2,000 francs), for his study of the centre of Indo-China and his ethnological work in Annam, Nicolas Menchikoff (2,000 francs), for his numerous expeditions in the Sahara and the Libyan desert with resulting contributions to geology, Edouard Fischer (1,500 francs), for his researches on the marine fauna of the Channel

Other Foundations

Pierre Lafitte Foundation to René Mesny (3,000 francs), for the whole of his work on radio electricity The Roy-Vaucouloux Foundation to Philippe Lasseur, for his work in the laboratory of microbiology at Nancy. The Charles Frémont Foundation to Léon Pomey (2,500 francs), for his work on geology and analysis.

University and Educational Intelligence

Cambridge.—A lecture on the Liversidge Foundation will be delivered by Prof R H. Fowler in the Lecture Theatre of the Engineering Laboratory on Friday, February 2, at 5 p m. The subject of Prof. Fowler's lecture will be "Heavy Hydrogen"

A LIBERAL education as a prophylactic against the manifold ills that threaten the very existence of western civilisation is the theme of an address delivered at Lehigh University on October 4 by Prof. Hans Zinsser and entitled "None of my Business: or Thoughts of a Biologist on Education" The address is printed in *School and Society* of November 25. The old problem of the relative cultural values of science and the traditional humanities is merged at the present day in another. how to determine the limits of the non-specialist and non-vocational parts of both, for a cultivated man of to day should possess as clear a comprehension of the fundamental laws of science as he does of classical culture and of the language and literature of his own country The great freedom of choice at present allowed in the earlier college years in the United States needs to be curtailed and there should be a far more rigid insistence than at present on a substantial minimum of mathematics distributed between those years and the high school, and general courses in the history of science, in physics, chemistry and biology should be combined with so much of the humanities as is indispensable for intelligent appraisement of the civilisation of our time

THE annual report of the University of Bristol records a small increase in the number of students and several interesting developments in the course of the year 1932–33 A link with New Zealand was established by the foundation of a Hiatt Baker memorial research scholarship of £200 a year tenable for two or three years by a graduate from New Zealand At a celebration of the centenary of the foundation of the medical school, the history of which by Dr G Parker was published without charge to the University by Messrs John Wright and Sons, Lord Dawson of Penn paid a tribute to the work of Prof Fawcett in the faculty of medicine over a period of nearly forty years In co operation with the City Council, the University established a department of preventive medicine which undertakes all the bacteriological, pathological and chemical examinations and research required from time to time by the corporation or its medical officer of health, who is ex-officio professor of preventive medicine A faculty of law was established with the help of contributions from local solicitors and others The university halls of residence were all full throughout the year

THE dispersal of German scholars frowned on in their own land for reasons connected with their political affiliation or racial origin has led to the establishment by the Institute of International Education in New York of a graduate faculty in political and social science comprising Profs Lederer, Brandt, Speier, Wunderlich and von Hornbostel of Berlin, Heimann of Hamburg, Feiler of Königsberg, Colm and Kantorowicz of Kiel and Wertheimer of Frankfort It is hoped that in the near future this faculty will be matched with others so as to form a general "university in exile", a rallying point for distinguished scholars displaced by political intolerance in Europe, and a medium for cross-fertilisation of American and European scholarship For the American student it would perform, by reason of its reproducing the spirit and method of German educational organisation, much the same service as he secured from one or two years of study in a German university. The scheme is described in the Institute's News Bulletin and a summary of it appears in *School and Society* of December 16.

Science News a Century Ago

Insects in the Heads of Mummies

The Rev F W Hope read a paper on January 27, 1834, before the Entomological Society (*J Proc*) in which he described several species of insects found in the heads of Egyptian mummies, some of which had been extracted from the head of a female mummy with plaited hair This was exhibited at the meeting by Mr. Wilkinson, the celebrated Egyptian traveller, by whom it was brought from Thebes. In the head of one mummy was found, it was said, a considerable quantity of the pupæ of dipterous insects . . and from their appearance Mr Hope was led to remark that the process of embalming could not possibly have been a rapid one Mr Pettigrew observed that in some mummies, however, no insects were discovered, as in the one recently opened at the College of Surgeons (see NATURE, Jan 13, p 74)

Currency Problems in the United States

Throughout the year, the United States continued to be agitated by the contest which had begun in the preceding year as to the legality of the conduct of the President in withdrawing the public deposits from the national banks Meanwhile, the importation of gold into the United States went on to an unprecedented extent The increase of specie between the beginning of January 1833 up to June 11, 1834, exceeded 20,000,000 dollars, and the excess of specie imported during the next nineteen days, above what was exported during the same period, came to about 2,000,000 dollars The result of this crisis was that a metallic currency was established for paper money ("Annual Register", 1834)

Drought in England

On the last day of January 1834 a drought began in England and Wales, and from that date until July 4 the rainfall was very limited. At Chiswick the total fall for the whole period amounted to only 4 7 inches, and over England and Wales as a whole the rainfall in the months of February to May inclusive was only 58 per cent of the normal In the early months high temperatures following a wet January caused the vegetation to be very forward, but a series of north-easterly winds and severe frosts in April brought disaster to the fruit crops July was rainy and thundery, but the drought returned in September and was severe in October, November and December. October 1834 appears to have been the driest month of that name in England and Wales between 1810 and 1933 inclusive

Lyell's "Principles of Geology"

In January 1834 the *Gentleman's Magazine* printed the following notice of vol 3 of Lyell's "Principles of Geology" —

"Those who have read the former volumes of Mr. Lyell will have recognised the great alteration and improvement which has taken place in the theory of Geology. The older geologists were more fitted for the island of Laputa than for a Philosophical Society, and even some of the latter were not far behind in pushing forward their crude fragments of discovery With them it was assumed that enormous changes and sudden and violent catastrophes, confounding and dislocating all the globe, were necessary to account for its present aspect Now Mr. Lyell's reasoning goes to the destruction of this ingenious but visionary fabric He considers that the operations *now* going on in the great workshop of nature are sufficient to show how the others that have preceded them have also moved. The changes in animated nature he refers to the circumstances in which the animals are placed Some animals are extinct that were existing a few years ago , others are changed in their nature, habits and climate ; thus, though unmarked except by the thoughtful eye of science, are changes now taking place very similar to those which have so long attracted the wonder and employed the attention of the sons of wisdom. The superentaceous groups form the subject of examination in the third volume Mr. Lyell's account of fossil shells is more extensive and important than ever was given before "

The Post Office

"In my opinion," wrote Lord Brougham, "the teachers of the age of George III covered it with still greater glory than it drew from the statesmen and warriors that ruled its affairs " Brougham himself was one of the first public men to concern himself with national education, and he was the founder of the Society for the Diffusion of Useful Knowledge To this Society was due the publication a century ago of the *Penny Magazine* and the "Penny Encyclopædia", to which many eminent men of science contributed The *Penny Magazine* was issued weekly with a monthly supplement and the supplement for January 1834 was devoted to "The History and Present State of the Post Office" "In the advanced state of civilisation to which we have now attained in this country," the article says, "we possess many advantages of the highest importance which are indeed essential to our daily comfort, but which, presenting themselves with unfailing regularity, pass without observance and almost without our being conscious of enjoying them " Among the principal of them, it was said, may be reckoned an efficient and well regulated system for the transmission of letters *not only in Great Britain but also all over the world* For inland letters the charges were 4*d* for 15 miles, 8*d* for 50 miles, 10*d* for 120 miles and, not exceeding 300 miles, 1*s* 1*d* When a letter weighed an ounce it was charged at four times the rate of a single letter It cost 3*d* to send a letter from Holyhead to Dublin and 6*d* from England to the Isle of Man Charges for overseas letters ranged from 1*s* 2*d* to France, to 2*s* 2*d* to America, 2*s* 10*d* to Gibraltar, 3*s* 2*d* to the Mediterranean and up to 3*s* 6*d* to Brazil Peers and members of parliament could frank ten letters daily The revenue of the Post Office, it was stated, amounted to £97,365 in 1754 , £952,893 in 1804 and £1,457,132 in 1832 The number of persons employed in the post offices of the country in 1829 was 4,905

Richard Lemon Lander

Richard Lemon Lander, the African explorer, died in Fernando Po on February 2 or 7, 1834 There is some doubt as to the actual date, as the accounts vary slightly in detail He was born in 1804 and even as a youth travelled widely, being in the West Indies when only thirteen and he crossed Cape Colony as the servant of Major Colebrook, a commissioner of inquiry, in 1823 With Clapperton, Lander went to West Africa and he brought home the news of Clapperton's death. He published the records of the expedition on his return to England. In 1830 Lander left England in charge of another expedition to the Niger On his return in 1831, he was awarded the first Gold Medal of the then recently formed Royal Geographical Society of London In 1832 a group of Liverpool merchants sent Lander on a new expedition to open up trade in the Niger basin While on this expedition Lander was wounded in an encounter with the natives of the Brass River region and returned to Fernando Po, where he died.

Societies and Academies

LONDON

Royal Society, January 18 B F J. SCHONLAND and H COLLENS · Progressive lightning Eleven lightning flashes, comprising fifty separate strokes from two separate thunderstorms, have been photographed with a rotating lens camera based upon the design of C V Boys The speed was fast enough to permit the study of the propagation of the discharge The majority of the strokes were double and consisted of a dart-like downward-moving leader stroke, followed immediately upon arrival at the ground by a more intense flame-like upward-moving main stroke The mean velocity of the leader strokes was $1\ 1\times10^{9}$ cm /sec along the tortuous track in two dimensions and $7\ 0\times10^{9}$ cm /sec in the vertical direction The dart was less than 54 metres long Corresponding mean velocities for the main strokes were $6\ 0\times10^{9}$ cm /sec and $3\ 8\times10^{9}$ cm /sec The leader strokes are identifiable with electron avalanches and the main strokes with thermally ionised channels The cloud base was negative and the earth positive

A O. RANKINE . A simple method of demonstrating the paramagnetism and diamagnetism of substances in magnetic fields of low intensity The instrument described is the result of an attempt to construct a magnetic gradiometer capable of measuring small distortions of the earth's magnetic field in the same way that the Eötvös torsion balance measures non-uniformities of gravity. Although this purpose has not yet been achieved, the first model of the instrument has revealed itself as a means of demonstrating the paramagnetism or diamagnetism of substances of small susceptibility Moreover, the magnetising fields employed are much smaller than has hitherto been customary, being of the order of 50 gauss or less. The system used also provides a basis for the construction of a new form of very sensitive galvanometer

C W GILBERT The production of showers by cosmic radiation Experiments made with triple coincidence counters showed that the frequency of showers produced in lead by the passage of cosmic radiation is proportional to the general cosmic radiation The transition curves for air to lead were obtained at 3,500 m , and it was found that there the energy of the shower particles was greater than at sea-level To explain the curves obtained, three types of radiation are needed, a primary radiation, a shower-producing radiation and the shower particles

PARIS

Academy of Sciences, December 18 (*C.R* , 197, 1545–1704). The president announced the death of Georges Friedel, *Correspondant* for the Section of Mineralogy. G PERRIER : The fifth general meeting of the International Geodesic and Geophysical Union at Lisbon, September 1933. A short account of the matters under consideration at the meeting L. Blaringhem. 'Fever' in *Arum*. The work of Garreau on the rise of temperature for some hours during the flowering of *Arum* is confirmed The seat of oxidation is in the male flowers and their support These consume 5–10 times as much oxygen as the female tissues André Blondel Observations on terminology in new discoveries. Examples are quoted to which objection may be made on linguistic grounds It is suggested that the various international commissions in existence should determine as soon as possible international words appropriate to the definition of new phenomena, but only after consultation with linguists W Venadsky, B Brunovsky and C Kunaševa γ-Mesothorium in *Lemna* *Lemna* concentrates the isotopes of radium (Ra, MsThI, ThX) but does not contain the isotopes of thorium. Hence the living material does not contain thorium Henri Lagatu and Louis Maume · The alimentary variations of cultivated plants, apart from the intervention of manure, under the conditions of practical agriculture Serge Rossinski · A case of deformation of isotropic congruences with persistent conjugated system P. Vincensini Associated systems and their transformations Al Pantazi Couples of stratifiable congruences. Mandelbrojt Some theorems on Fourier's series. Robert Gibrat A fairly general type of singular integral equations Florent Bureau Systems of two uniform functions of two complex variables. Arnaud Denjoy Integration along closed rectifiable ensembles. N Aronszajn : The invariants of transformations in the domain of *n* complex variables A Métral Precession in gyroscopic phenomena Silvio Minetti Integration with a single quadrature of the movement of regular precession Simon De Backer Atmospheric turbulence D. Riabouchinsky Lines of emission. Max Serruys. The rôle of peroxides in the knocking of petrol motors From the experiments described, the authors conclude that peroxides are not the sole cause of detonation, but only one element favourable to its appearance. Bernard Lyot A monochromator with a large field utilising interference in polarised light. L. Goldstein. The complex process of materialisation L Bouchet Dry batteries with a solid radioactive electrolyte and ionised air. Mlle. M. Chenot The discharge produced by the superposition of a constant field and a high frequency field. E Cabanel and J. Cayrel · The point effect and crystal detection Although the use of a metallic electrode in the form of a point is favourable when used with sensitive galenas, the point effect cannot be considered as the cause of the detection, but acts only as a secondary factor

(*To be continued*)

SYDNEY

Royal Society of New South Wales, Oct. 4. Adolph Bolliger: Volumetric determination of methylene blue and picric acid. Small amounts of methylene blue and picric acid can be titrated against each other with a high degree of accuracy. The sparingly soluble compound formed, namely, methylene blue picrate, can be readily removed with chloroform, in which it is very soluble. The end point is reached when the watery layer becomes colourless. L. W. O Martin. Quantum numbers and valency. On the basis of London's generalisation of the non-ionic bond and Pauli's exclusion principle, the principal quantum numbers (n, l) of the electron pair bond between two elements are determined It is shown, in the cases examined, that the element of higher atomic number determines the value for n, and therefore that the electron belonging to the atom of lower atomic number must be promoted A connexion between the degree of promotion and the strength of the bond is shown to exist The chemical reactivity is also connected with this promotion

WASHINGTON, D C

National Academy of Sciences (*Proc*, **19**, 879-938, Oct 15) Donald H Menzel and Roy K. Marshall. Neon absorption lines in stellar spectra. A list of identifications is given, indicating that neon is comparatively abundant in the universe Edwin B Wilson. Transformations preserving the tetrad equations Dietrich C Smith Colour changes in the isolated scale iridocytes of squirrel fish, *Holocentrus ascensionis*, Osbeck Observations similar to those made by Foster on iridocyte aggregations beneath the scales of *Fundulus* (see Nature, **132**, 456, Sept 16, 1933) have also been made on the iridocytes in the scales of the squirrel fish Earl H Myers : Multiple tests in the Foraminifera. Observations on living Foraminifera show that in many families the occurrence of two or more shells cemented together with the apertures approximately opposed (multiple tests) is the result of the union of two or more individuals for reproductive purposes (plastogamy) with the production of 'zoospores' J L Walsh · An extremal problem in analytic functions. Einar Hille and J D Tamarkin (1) On moment functions (2) On the theory of Laplace integrals. Joseph Miller Thomas. A lower limit for the species of a Pfaffian system Morgan Ward A property of recurring series M H. Johnson, Jr : Intensities in atomic spectra A theoretical discussion leading to the determination of the electric moment with a definite scheme of coupling of the orbital and spin angular momenta, from which the electric moment matrix in intermediate coupling is derived. The components of the latter determine the intensities of the spectral lines. Thomas Wayland Vaughan. The biogeographic relations of the orbitoid Foraminifera Related living Foraminifera are characteristic of shoal water of the tropics and sub tropics, suggesting a similar environment for the orbitoids Since the orbitoids were bottom dwellers, wide geographical distribution requires planktonic larval stages, indirect evidence of which is provided by the observation by Myers of the production of floating 'zoospores' from certain living Foraminifera (see above). Such distribution would probably require a number of sub-oceanic peaks and ridges where there is now deep ocean. Hydrographic and other data suggest that the routes of migration were (*a*) Upper Cretaceous, between Europe and India by way of Tethys and between Europe and America across the Atlantic, (*b*) Eocene, along Tethys, across the Atlantic and from east to west of America, (*c*) Oligocene and most of Miocene, across Central America between the Atlantic and Pacific, thence to the Pacific islands probably to the East Indian region, as well as across the Atlantic and possibly round the southern end of India, but not round the south of Africa.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, January 29

ROYAL GEOGRAPHICAL SOCIETY, at 5 30 —T A Glover "From Senegal to Italian Somaliland" (Geographical Film)

UNIVERSITY COLLEGE, LONDON, at 5 30 – Dr R E M Wheeler 'Race and History in Ancient Europe" *

EAST LONDON COLLEGE, at 5 30 —L H Bedford "Low Voltage Oscillographs" (succeeding lectures on February 5, 12 and 19) *

Wednesday, January 31

ROYAL SOCIETY OF ARTS, at 8 —Alan E L Chorlton, M P "The Pooling of Water Supplies"

Thursday, February 1

KING'S COLLEGE, LONDON, at 3 –C J Gadd 'Some Babylonian Myths and their Influence in Israel" *

ROYAL SOCIETY, at 4 30 —A K Denisoff and Prof O W Richardson 'The Emission of Electrons under the Influence of Chemical Action"

Sir Robert Robertson, J J Fox and A E Martin Two Types of Diamond"

Friday, February 2

UNIVERSITY of CAMBRIDGE, at 5—(in the Engineering Laboratory) Prof R H Fowlor 'Heavy Hydrogen" (Liversidge Foundation Lecture)

BEDSON CLUB, at 6 30—(at Armstrong College, Newcastle upon Tyne) —Dr G C Simpson 'The Physical and Chemical Constitution of the High Atmosphere" (Bedson Lecture)

Official Publications Received

GREAT BRITAIN AND IRELAND

The Cretan Labyrinth a Retrospect of Ægean Research (The Huxley Memorial Lecture for 1933) By J L Myres (Reprinted from the *Journal of the Royal Anthropological Institute*, Vol 63) Pp 269-312 (London Royal Anthropological Institute) 2s 6d net

The Pharmaceutical Society of Great Britain Codex Revision Committee Report of Pharmacy Sub Committee Summary of the Principal New or Revised Formulæ recommended by the Pharmacy Sub Committee for inclusion in the British Pharmaceutical Codex, 1934 Pp 49 (London Pharmaceutical Press) 2s 6d

Torquay Natural History Society Transactions and Proceedings for the Year 1932-3 Vol 6, Part 3 Pp 175-267 (Torquay)

Air Ministry Meteorological Office, London Southport Auxiliary Observatory (The Fernley Observatory of the Corporation of Southport) Annual Report, and Results of Meteorological Observations, for the Year 1932 , with an Appendix By Joseph Baxendell Pp 31 (Southport Fernley Observatory , London Meteorological Office)

Abstracts of Dissertations approved for the Ph D , M Sc and M Litt Degrees in the University of Cambridge during the Academical Year 1932–1933 (Published by Authority) Pp 119 (Cambridge Printed at the University Press)

The University of Manchester The Manchester Museum Museum Publication 104 Report for the Year 1932-33 Pp 23+1 plate 6d net Museum Publication 105 A Short Guide to the Manchester Museum By Dr George H Carpenter Pp 16+7 plates 3d net (Manchester University Press)

The Scientific Proceedings of the Royal Dublin Society Vol 21 (N S), No 1 Some Measurements of the Brightness of Various Parts of the Sky by means of a Rectifier Photo-Electric Cell By Dr H H Poole and Dr W R G Atkins Pp 8 (Dublin Hodges, Figgis and Co , London Williams and Norgate, Ltd) 6d

OTHER COUNTRIES

Southern Rhodesia Geological Survey Bulletin No 24 The Geology of the Lower Gwanda Gold Belt By A E Phaup Pp 74+3 plates (Salisbury Government Printer) 2s 6d

India Meteorological Department Scientific Notes, Vol 5, No 55 On the Nature of the Frequency Distribution of Precipitation in India during the Monsoon Months, June to September By D Sankaranarayanan Pp 97–107+2 plates (Delhi Manager of Publications) 10 annas , 1s

Memoirs of the India Meteorological Department Vol 26, Part 2 The Indian Southwest Monsoon and the Structure of Depressions associated with it By Dr K R Ramanathan and K P Ramakrishnan Pp 13 36+11 plates 2 10 rupees , 4s 9d Vol 26 Part 3 On the Physical Characteristics of Fronts during the Indian Southwest Monsoon By N K Sur Pp 37–50+12 plates 1 9 rupees , 2s 9d (Delhi Manager of Publications)

Conseil Permanent International pour l'Exploration de la Mer Bulletin hydrographique pour l'année 1932 Pp x+112 7 00 kr Journal du Conseil Rédigé par E S Russell Pp 309–438 4 50 kr (Copenhague Andr Fred Høst et fils)

Department of Agriculture Straits Settlements and Federated Malay States General Series, No 15 Reports of the Field Branch for the Year 1932 Pp iii+209+5 plates (Kuala Lumpur) 50 cents

Egyptian Government Ministry of Public Works Annual Report for the Year 1927–1928, Part 2 Pp xiv+283+13 plates (Cairo Government Press) 20 P T

Smithsonian Institution United States National Museum Contributions from the United States National Herbarium, Vol 26, Part 7 The Mexican and Central American Species of Viburnum By C V Morton Pp vii+339–366 (Washington, D C Government Printing Office) 5 cents

U S Department of Agriculture Circular No 287 Burning for the Control of Aphids on Alfalfa in the Antelope Valley of California By R A Blanchard, H B Walker and L K Hedden Pp 24 5 cents Circular No 289 Observations on the European Corn Borer and its Major Parasites in the Orient By W B Cartwright Pp 14 5 cents Technical Bulletin No 395 Subfreezing Temperatures Lethal to the European Corn Borer infesting Green Ears of Sweet Corn By C H Batchelder and D D Questel Pp 14 5 cents (Washington, D C Government Printing Office)

Geological Series of Field Museum of Natural History, Vol 6 Preliminary Description of a New Marsupial Sabertooth from the Pliocene of Argentina By Elmer S Riggs Pp 61–66 10 cents A New Devonian Trilobite from Southern Illinois By Sharat Kumar Roy Pp 67–82 20 cents (Chicago)

Zoological Series of Field Museum of Natural History, Vol 20 The South American Mice referred to Microryzomys and Thallomyscus By Wilfred H Osgood Pp 8 10 cents A New Snake from Arabia By Karl P Schmidt Pp 9–10 10 cents Two New Rodents from Argentina By Wilfred H Osgood Pp 11–14 10 cents New Reptiles and Amphibians from Honduras By Karl P Schmidt Pp 15–22 10 cents Bats of the Genera Anoura and Longchoglossa By Colin Campbell Sanborn Pp 23–28 10 cents Preliminary Account of the Coral Snakes of Central America and Mexico By Karl P Schmidt Pp 29–40 10 cents Notes on Fishes of the Family Hemirhamphidæ By Alfred C Weed Pp 41–66 15 cents (Chicago)

Proceedings of the California Academy of Sciences, Fourth Series Vol 21 The Templeton Crocker Expedition of the California Academy of Sciences, 1932 No 10 Marine Mollusca from Acapulco, Mexico, with Notes on other Species By A M Strong, G D Hanna and L G Hertlein Pp 117–130+plates 5–6 No 11 The Hippoboscidæ of the Galapagos Archipelago (Notes on the Hippoboscidæ, 8) with an Appendix on the Tabanidæ By Joseph C Bequaert Pp 131 138 No 12 The Diurnal Lepidoptera of the Expedition. By E P Van Duzee Pp 139–146 (San Francisco)

The Storage Behaviour of Limes By Dr Claude W Wardlaw Pp 23 (Trinidad Government Printing Office) 2s 6d

The Imperial Council of Agricultural Research Scientific Monograph No 8 The Silk Industry of Japan, with Notes on Observations in the United States of America, England, France and Italy By C C Ghosh Pp viii+127+28 plates (Delhi Manager of Publications) 4 rupees , 6s 9d

The Indian Forest Records Vol 19, Part 2 Entomological Investigations on the Spike Disease of Sandal (13) Membracidæ and Cercopidæ (Homopt), Supplementary Data By N C Chatterjee and M Bose Pp iii+10 (Delhi Manager of Publications) 4 annas , 5d

Punjab Irrigation Research Institute Research Publication, Vol 1, No 4 An Investigation of the Rise of Water Table in the Upper Chenab Canal Area, Punjab By Dr E McKenzie Taylor, J K Malhotra and M L Mehta Pp 39+6 plates (Lahore Punjab Irrigation Research Institute) 12 annas , 1s 2d

Memorias del Consejo Oceanográfico Ibero Americano No 14 Por qué el Perú necesita un estudió de la corriente que lleva su nombre Por R Torrico Pp 19+5 plates (Madrid)

Bulletin of the Bingham Oceanographic Collection Vol 3 Scientific Results of the Third Oceanographic Expedition of the *Pawnee*, 1927 Art 6 Deepsea Berycomorphi and Percomorphi from the Waters around the Bahama and Bermuda Islands By Albert Eide Parr Pp 51 Vol 4, Art 5 A Revision of the Genus Gobiosoma (Family Gobiidæ), with an Account of the Genus Garmannia By Isaac Ginsburg Pp 59 (New Haven, Conn Bingham Oceanographic Foundation)

Suomalaisen Tiedeakatemian Toimituksia (Annales Academiæ Scientiarum Fennicæ) Sarja (Serie) A, Nid (Tom) 37, No 11 Ein Beispiel des Zerspringens in Schwingung geratener Glasgegenstände Von G Melander Pp 5 (Helsinki)

U S Department of Agriculture Farmers' Bulletin No 1713 The Treatment of American Foulbrood By Jas I Hambleton Pp ii+14 (Washington, D C Government Printing Office) 5 cents

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CATALOGUES, ETC

The Hilger Vitameter A an Apparatus for Measuring the Vitamin A Chromogen Content of Cod and other Fish Liver Oils (Publication No 191/2) Pp 6 (London Adam Hilger, Ltd)

The *Chemist and Druggist* Diary, 1934 (Sixty-sixth Year of Publication) Pp 436+Diary (London The *Chemist and Druggist*)

Calendar for 1934 (London . The *Chemical Trade Journal*)

The "MS" Automatic Rapid Action Voltage Regulator (List No V 1133) Pp 6 The I R Voltage Controller (List I R 134) Pp 12 (London Isenthal and Co , Ltd)

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Industrial Economics

UNTIL 1914, the industries of Great Britain progressed more or less on an even path, developing on conservative lines and only slowly adopting the inventions resulting from scientific research The clash of peoples in the War had a violent repercussion on industry throughout the War, production was pressed to the utmost, there was a free interchange of information, and scientific invention was applied in a hitherto unprecedented manner Post-War trade has experienced first a boom in 1919-20, then a slump lasting until 1925, followed by another and greater boom lasting to the end of 1929, and by an unprecedented depression from which it is beginning slowly to emerge During all these periods, science and invention have been applied to industry as never before, there was money available during the boom periods and need for economy in production costs during the slump

If we take stock to-day, much will be found to have changed, some of our old industries are hard hit almost beyond recovery, newer and more scientific industries have arisen which may be expected to take their place If British industry makes the mistake of attempting to perpetuate the past, the outlook is serious, and apparently it is still foreign to the nature of those who control industry to experiment on the large scale or to act as pioneers of new and untried industries, but fortunately we are proving adept at taking up these newcomers when their teething troubles are past and they have reached the stage of being really practical as well as remunerative, which is more important from a business point of view

Economists have preached from many texts during the depression, at times there have been as many doctrines as preachers—a fact which arises, in our belief, from insufficient knowledge of the practical details of an industry and also perhaps from the inability to grasp the problem as a whole The factors are too numerous to fit into any one theory, their inter-play too obscure to follow easily

Prof Allen, in a most readable book*, has recently attempted to give a picture of the major British industries as they are at present organised After tracing the chief features of industrial development up to 1914, indicating in particular the relative importance of the major trades in the economic life of the nation, he takes several of these trades in turn to describe their rise to prominence, their fortunes during the last decade and their organisation. His selection comprises the staple trades, coal, iron and steel, engineering, shipbuilding, automobiles, and cotton and woollen textiles: it could with advantage have included the chemical and the electrical industries, in which new and progressive methods predominate. He summarises the post-War history and concludes with a chapter on changes in the structure of industry. They are indeed profound, and if the man of science is to go outside his specialised subject, and help the nation at large, he must seek to study them carefully and try to understand their significance.

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* British Industries and their Organisation By Prof. G C Allen Pp xi+338 (London, New York and Toronto Longmans, Green and Co Ltd, 1933) 10s 6d net

Instability of demand is one of the most difficult problems of modern business. Fashion has a greater and wider influence than ever before, due to the widespread circulation of the newspaper and perhaps also to cheap travel and an accelerated news service. Sir Josiah Stamp has indicated how the increased purchasing power resulting from a fall in the price of boots, due to improved methods of manufacture, may be devoted to the buying of gramophones, so setting up a new industry and providing new employment. But at any moment, the public may leave gramophones for a new interest, for example, radio, and the elaborate and costly plant and organisation built up to supply gramophones fall on evil days. In a sentence, the demand for goods and services satisfying secondary needs is less stable than is the demand for the necessities of life. It is indeed optional and erratic, as witnessed by the fact that one result of the universal adoption of the cigarette-smoking habit by our women-folk has been a diminution in their consumption of chocolates.

A like change has come over the markets for raw materials—in part due to chemical discovery—which is likely to play a continually growing part henceforth. There are enthusiasts who claim that the chemical revolution will bring lower costs, a far wider range of raw materials, a growing multitude of new products and the increasing replacement of familiar wares by superior synthetic articles. Cheaper goods, more goods, new goods, will tend to keep the wheels of industry turning, to make more work, to create new wealth, to distribute purchasing power more broadly. On the other side of the picture, these changes in the sources of raw materials will alter the relative advantages of different countries for specific manufacturing industries.

The change is inevitable, the problem of the transference of national resources to other activities must be faced: the future means more research by a greater number of workers, or perhaps, as Mr. E. W. Rice has said recently in the United States, "the time will come in industry when research will be regarded as more important than advertising". As Prof. Allen rightly emphasises, the economic system has become more rigid. Wage rates are inelastic, oncosts make up a high proportion of the total cost, mass-production technique, standardisation, rationalisation, all have had their effect. It would seem, he says, that technical factors have been given too much weight in determining the organisation of production, whilst widespread national advertising and instalment-selling have accentuated the instability of demand.

The elimination of the small firm by larger corporations with greater resources and apparently also greater bank protection, has eliminated in times of crisis what used to be termed 'healthy bankruptcy'. Output is maintained in times of stress at the bare cost of labour and materials without any contribution to overheads. Such competition is ultimately fatal, not only to the firm but also to the industry, to the nation and to the world—it is equivalent to slow decay. Such a policy is, more than any other reason, in our opinion, the cause of the present world crisis.

There have been great changes also in administrative methods—indeed a new science of industrial management is being evolved which will in time bring order out of chaos. The delegation of authority in a great business is a most important problem—the specialist is replacing the all-rounder. We find planning, employment, costing, purchasing and stores departments all entrusted with specific duties, the work of which has in turn to be co-ordinated.

Another problem is that arising out of joint stock management by experts for shareholders in substitution for that of interested owners. The disappearance of the family business has involved a loss of personal relationships with the workpeople, which can only be regretted. Labour claims a greater voice in industry; much depends on the wise solution of these claims by co-partnership or some other means. Topics of this kind surveyed by Prof. Allen will well repay serious consideration by all who seek to be in touch with the most important of our national problems. We live by industry, not by politics.

E. F. A.

Human Biology and Legalised Sterilisation

THE Report of the Departmental Committee on Sterilisation, which was appointed in 1932 to examine and report on the information available regarding the hereditary transmission and other causes of mental disorder and deficiency, to consider the value of sterilisation as a preventive measure, and to suggest what further inquiries might usefully be undertaken in this connexion, was issued on January 18. The Report is a most valuable summary of modern knowledge relating to an urgent social problem. It surveys the causes and extent of mental disabilities, considers the results of sterilisation, and makes important recommendations for a change in the law and practice in Great Britain. A survey of Dominion and foreign legislation relating to sterilisation is included, so that the Committee's own recommendations can be considered in the light of practice in other parts of the world.

The Committee recommends that voluntary sterilisation should be legalised in the case of a person who is mentally defective or who has suffered from mental disorder; a person who suffers from, or is believed to be a carrier of, a grave physical disability which has been shown to be transmissible; and a person who is believed to be likely to transmit mental disorder or defect. The Committee was, of course, mainly concerned with the question of sterilisation. The constitution of the Committee was such as to make it possible for the Report to include the statement that "we may perhaps be allowed to say that our recommendations are *not* a compromise between conflicting views adopted reluctantly in order to secure the appearance of agreement. On the contrary, we were fortunate at the end of a long enquiry in finding ourselves in complete harmony". This in itself distinguishes this Report from that recently issued by a Committee of the British Medical Association.

The Report expresses the opinion strongly that sterilisation should be voluntary, and insists on stringent medical and administrative safeguards to prevent hasty operations. It urges that the same procedure should apply for physical defects which are known to be inherited. It emphasises the point of view that sterilisation cannot replace institutional treatment, and that even if voluntary sterilisation were adopted on the largest scale, there would still be need for more and not less institutional accommodation than is at present available. Finally, the Report stresses the need for further research in several fields. It points out the striking fact that almost all State-aided research in heredity has been inspired by agricultural needs, and asks whether human heredity is not as important as that of cattle and wheat.

From the volume of adverse criticism even now appearing in the popular Press, it is to be assumed that the Committee's recommendations will meet with great opposition in Parliament and that in all probability they will not gain the support of law. It is improbable that any political party will incorporate these recommendations in its own programme, though this may happen perhaps in ten or twenty years' time. In the meantime, it must be sufficient to rejoice in the fact that it is now becoming officially recognised that man is in charge of his own destiny and that no kind of absolute authority will prevent us from tackling our own problems. The Report possesses a unique interest, for it represents the first attempt in Great Britain to apply pure biology in social practice. It is a scientific document, and its recommendations are in no way coloured by religious or political considerations. It heralds a new era in social legislation.

A Panorama of Geometry

Principles of Geometry. By Prof. H. F. Baker. Vol. 5: *Analytical Principles of the Theory of Curves.* Pp. x+247. (Cambridge: At the University Press, 1933.) 15*s*. net.

IT will be immediately admitted by all mathematicians that the foundations of pure geometry were well and truly laid by the Greeks in the period preceding and succeeding the time of Christ. They investigated in great detail the properties of the straight line, the circle and the conic sections. They had few general principles governing their researches; they were on the outlook for interesting geometrical properties wherever they could find them. On the other hand, Euclid attempted to collect all these scattered theorems and to present them in a coherent whole, studying at the same time so far as he could the underlying postulates and axioms. Nevertheless, it still remains true that the discovery of individual theorems was rather at haphazard.

It fell to Descartes (1596–1650) to devise the geometrical representation of an equation in x and y by means of abscissæ and ordinates. Thus was introduced a general method of attacking any geometrical problem, and furthermore the notion of the 'degree' of a curve obtruded itself It became apparent that the 'straight line' of the ancients was no more and no less than the geometrical representation of an equation of the first degree in x and y Similarly, the conics, including the case of the circle, are merely geometrical representations of equations of the second degree in x and y

Acting on these general ideas, Newton (1642–1727) and Maclaurin (1698–1746) attacked the curve of the third degree (usually called the cubic curve), and made substantial discoveries It was not, however, until the middle of the nineteenth century that any progress could be made with the curve of the fourth degree Its bitangents were discussed by Steiner (1796–1863) and Hesse (1811–1874) The properties of the plane quintic curve have been investigated during the last ten years, but practically nothing is known about the general sextic curve, though a considerable amount of research has been done on particular types of sextics

Simultaneously with these explorations into the properties of plane curves of successive degrees, came investigations into surfaces of the first and second degrees, that is, planes and quadrics The surface of the third degree received detailed treatment at the hands of Steiner, Sylvester (1814–1897), Salmon (1819–1904), Cayley (1821–1895) and others Little is known about the general quartic surface, though much information has been obtained about special types These researches into concrete curves and surfaces of the lower degrees inevitably led to speculations as to the more general characters of curves and surfaces, and particularly those possessing double points and cusps An epoch-making discovery that transformed the whole aspect of geometry was made by Plücker (1801–1868) when he found the exact effect of the possession of double points or cusps upon the number of double tangents, points of inflexion, and tangents from a point that the general undegenerate curve possesses

Another profound influence, though affecting pure geometry less directly than those above mentioned, underlay the discoveries of Abel (1802–1829). By his work on algebraic functions and their Abelian integrals, this young mathematician, caught off in early manhood by tragic death, in the words of Hermite "a laissé aux mathématiciens de quoi travailler pendant cent cinquante ans" The geometrical interpretation of Abel's theorems leads at once to the study of linear systems of points on a curve The possibilities of Abel's work were extended by the work of Jacobi (1804–1851) on the theta functions and of Riemann (1826–1866) on the surfaces that bear his name Jacobi's work on the theta functions leads immediately to the study of contact curves and surfaces There is no textbook which will give a better idea of the general outlook in the middle of last century on geometry as affected by the development of Abel's discoveries than "Theorie der Abelschen Functionen (1866)" by Clebsch (1833–1872) and Gordan (1837–1912) This book in 333 pages develops the theory of the theta functions from first principles, avoiding all general function theory and using only the methods of relatively elementary algebra and geometry Throughout, the book is frankly geometrical in its outlook and even in its notation The student of the history of geometry cannot afford to neglect this work and it will well repay perusal

The general idea of the genus of a curve soon obtruded itself from several quarters There are p Abelian integrals of the first kind A plane algebraic curve which has p double points or cusps less than the maximum number that it may have without degenerating has several characteristic properties Thus a curve of genus (or 'deficiency') zero can have its co-ordinates x, y, z expressed as polynomials of a single parameter t A curve of genus or 'deficiency' one requires the use of elliptic functions for the expression of x, y, z in terms of a single parameter U The reduction of an n-sheeted Riemann surface to one of two sheets with p holes in it presents the same result from still another point of view

These basic ideas gave an impetus to the study of the higher geometry in every direction Space forbids any further preliminary discussion, but it seemed desirable to give the above rough and very incomplete sketch in order that those whose interests are not primarily geometrical should be able to form a competent view of the setting of the field, with which Prof H F Baker's vol 5 of the "Principles of Geometry" is concerned

Prof Baker has placed mathematicians in general and geometers in particular under a very deep obligation for his six volumes on the principles of geometry Their design is to lay before the reader a panorama of the subject and Prof. Baker has achieved his main object extraordinarily well Not only can the general mathematical reader obtain a deep and detailed insight into the development of algebraic geometry, but also the professional geometer will never fail to find something new in these pages. It has been a tremendous task carried out with Tolstoyian vision

Vol 1 deals with "Foundations", vol 2 with "Plane Geometry (conics, circles, non-euclidean geometry)", vol 3 with "Solid Geometry (quadrics, cubic curves in space, cubic surfaces)", vol 4 with "Higher Geometry (being illustrations of the utility of the consideration of Higher Space, especially of *four and five dimensions*)"; vol 5 with the "Analytical Principles of the Theory of Curves", vol 6 with an "Introduction to the Theory of Algebraic Surfaces and Higher Loci". Vol 5 is that immediately under review. It consists of eight chapters dealt with in 247 pages Chap i is an introductory account of rational and elliptic curves, chap ii deals with the elimination of the multiple points of a plane curve; chap iii with the branches of an algebraic curve, the order of a rational function, Abel's theorem, chap iv with the genus of a curve, fundamentals of the theory of linear series, chap v with the periods of algebraic integrals, loops in a plane, Riemann surfaces, chap vi with the various kinds of algebraic integrals, relations among periods; chap vii with the modular expression of rational functions and integrals, chap viii with enumerative properties of curves

The general structure of vol 5 and its place among the other volumes of Prof Baker's series will now be clear He deals in it with the researches of a hundred and thirty years The book is general in character and presents by no means easy reading throughout This is only to be expected where the subject-matter is often so essentially fundamental in character, but the author has very judiciously inserted copiously concrete examples from the case of specific curves and surfaces, and thus the reader's feet are kept on firm rock and he is not allowed to lay down the book with a notion of the treatment of vague generalities The first part of the volume deals with linear series of curves and the sets of points they cut out on the basic curve by the methods of algebraic geometry; the second part presents much of the same subject-matter from the point of view of Abel's integrals and Abel's theorem. The theta functions and contact curves are mentioned but do not receive detailed treatment The Riemann-Roch theorem and its consequences are expounded in great detail.

It only remains to add that vol 5 has been printed with all the finish that one has learned to expect from the mathematical works issued by the Cambridge University Press The treatment itself displays on every page the profundity of learning and mathematical resource that one has long associated with the name of its distinguished author W P M.

Research and the Community

Ideals of a Student By Sir Josiah Stamp Pp 240 (London Ernest Benn, Ltd, 1933) 8*s* 6*d* net

SIR JOSIAH STAMP is known to all as the president of the executive of the LMS Railway, and as a leading authority on the theory and practice of public finance Apparently he has two major forms of relaxation One is the reading of books on all possible subjects, from the Law Reports to the textual criticism of the New Testament, and from seventeenth century books on morals to the latest publications in physics, biology, economics, psychology and philosophy. The other is giving addresses to universities and educational societies, both in Great Britain and in North America, on topics appropriate to these bodies His latest book is a synthesis of these two hobbies It welds together in a continuous argument the themes of perhaps twenty speeches and talks delivered on various occasions during the past few years, and it contains the cream of his reflections upon his 'holiday reading', amply supported with quotations and comments

There is in truth something Aristotelian about Sir Josiah Stamp He has Aristotle's encyclopædic knowledge and Aristotle's philosophically matter of fact approach to the problems of life and learning He has to a great degree Aristotle's literary style—the same series of jerky paragraphs, not always well rounded or carefully coupled with one another, the same love of appropriate, if allusive anecdote, the same readiness to put in the closest juxtaposition discussions of first principles and advice on day to day conduct—in a word, the same sturdy refusal to allow the outpourings of a well-stocked mind to be cramped by the bonds of systematic exposition The argument of his book would have commended itself to his great predecessor For he is concerned with the two main problems which exercised Aristotle when he wrote the *Ethics*—the problem of "theoretical wisdom", or the search for truth, and the problem of "practical wisdom", or the ways in which knowledge can help us in the ordering of our lives

Broadly speaking, the former subject is the theme of Chaps iii, iv, and vii, and the latter of Chaps i, ii, v, and vi Chaps iii and iv discuss the function of universities as institutions for the furthering of knowledge They are remarkable for the understanding which they show of the special problems facing researchers in all the main fields of learning They will be a source of encouragement to those who have feared that doctoral theses, at any rate in literature and the social sciences, are largely a waste of time

Sir Josiah Stamp does not despise even investigations into methods of dish-washing or into the reactions of the young to the emotional stimuli of the 'movies' He is also more sympathetic than most of us towards the desire of the writers of theses to have them published Neither for detailed pieces of work nor for knowledge as a whole does he believe in the overriding necessity for finality , and in Chap vii he urges that since our knowledge of the universe must be incomplete, we need not be too greatly upset if (as in physics at present) we cannot always reconcile it with itself

On the problem of the relation of theoretical knowledge to practical problems Sir Josiah is equally helpful In Chaps i, ii, and vi, he examines the part that must be played by universities and schools of economics in the modern world He sees one of the chief dangers in the present situation in the fact that so many of our political and economic problems require a greater general knowledge and (still more) a higher capacity for weighing evidence and judging impartially, than the average citizen of to-day possesses Universities can put this right if they will both train their students in the technique of research and also provide them with an understanding of the unity of modern problems Chap v, "On Improving all Things", discusses one particular aspect of this subject—the relation of Christian ethics to the problems of capital versus labour, and nationalism versus internationalism This is perhaps the only part of the book in which Sir Josiah's wide sympathies and his ability to see both sides of every question lead to his becoming ineffective, and perhaps doing less than justice to his own convictions It is fairly clear from the rest of his work that he really believes nationalism to be a main source of our economic and political troubles Why, then, does he not say so openly and unequivocally ?

L M FRASER

A Modern Flora

The Flora of Leicestershire and Rutland . a Topographical, Ecological, and Historical Account with Biographies of Former Botanists (1620–1933) By Arthur Reginald Horwood and the late Charles William Francis Noel (Lord Gainsborough) Pp cccxvii+687+36 plates (London Oxford University Press, 1933) 35s net

THIS extensive work comprises about a thousand pages of small print When it is taken into account that Leicestershire is a county rather poor in species, including, as the author states, only about one half of the known British species, it is clear that much of the book is taken up with matter not usually included in a flora The bulk of this matter is in the 300 pages of introduction, which gives chapters not only on the geology, meteorology, soils, agriculture and botanical districts of the region covered, but also on the ecology of the counties, together with a very comprehensive section on the local botanical collections and investigations, with full biographies of those concerned This is indicated by the subtitle In all cases Rutland is dealt with separately.

What may be named the new features of the flora proper consist largely of a meticulous account of first records and the attempt to refer each species to what may be termed its ecological home There will be many botanists, and it is to be hoped field naturalists also, who will agree with Mr. Horwood as to the importance of the geological and ecological factors in their bearing on the occurrence and distribution of the elements of a flora, but many will also feel that it is possible to overweight a flora even in these respects and particularly in matters of biography In any event it may well be thought that the desirability of including ecology in floras is as yet something of a counsel of perfection, in view of the comparative paucity of ecologists and ecological data as compared with collectors and collections. It is greatly to be hoped that one day we may have *ecological* collections, reference to which will probably tend in time to reduce the recorded number of varieties, if not of species

Since as a specialised study and indeed a sub-science ecology belongs almost to the present century, and has arisen entirely during the fifty years since the issue of the previous "Flora of Leicestershire" in 1886, the new "Flora" reflects very well one of the great developments of botanical science which has arisen in the interval.

The authors are to be congratulated therefore on the ecological atmosphere with which they have infused the book They might perhaps also—in view of the generous plan of the work—have included some remarks on the even more important and voluminous edifice built up by the geneticists during this period and its bearing on hybrid species Seventy-two hybrids are reported in the summary furnished by Mr Wade.

The change in the flora itself during the fifty years is shown by the enumeration of 50 species which have become extinct and of others erroneously recorded, on the other hand, one may quote *Pyrola minor*, discovered in 1913, as one of the additions

The 1933 "Flora of Leicestershire and Rutland" is undoubtedly a splendid work of reference, adorned with excellent maps and photographs, incorporating as it does much more scientific information than one had any right to expect of a flora, but possibly a precursor of a new type Nevertheless its issue in two volumes would probably have added to its usefulness

The Committee which has remained in being for twenty years (1912–1933) is to be congratulated on its tenacity and generosity in finally overcoming all difficulties, and, through the labours of Mr Horwood, bringing its work to a successful conclusion E N M T

Short Reviews

Hydraulics By Prof Horace W King and Prof Chester O Wisler Third edition, revised Pp xii+292 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1933) 16*s* 6*d* net

IT is a significant instance of the mutability of word meanings that the term hydraulics, which a generation or more ago was limited to the practical applications of the science of hydrodynamics, distinct alike from that subject in its theoretical aspect (that is, neglecting viscosity) and from hydrostatics, is now very commonly used to denote the whole field of hydromechanics. In an authoritative article by the late Prof. Unwin, in the ninth (1881) edition of the "Encyclopædia Britannica" the distinction just given is clearly drawn On the other hand, in the textbook under notice, as also in other cases, the writers treat hydraulics as an omnibus subject comprising the three divisions of hydrostatics, hydrokinetics and hydrodynamics

It is obvious, of course, that no satisfactory knowledge of the behaviour of water in motion can be acquired without some fundamental acquaintance with its characteristics when at rest, but this is not quite the same thing as making hydraulics a compendium of the physics of water. One disadvantage which presents itself is that the field becomes too wide for effective treatment in brief compass, and the writers of the present exposition cannot claim to have covered the whole of the ground in the book of less than 300 pages.

About one-sixth of the work is devoted to hydrostatics, and roughly the same amount to theoretical hydrokinetics and hydrodynamics The remainder relates to hydraulics in the old sense of the word, and provides a consideration of flow through orifices and tubes, over weirs and dams and in pipes and open channels, including both uniform and non-uniform flow, the latter being a subject of some novelty in textbooks The present issue is the third edition, so that the book has attained a satisfactory measure of acceptance, which is justified by the clarity of treatment, both in regard to the text and the diagrams Students will undoubtedly find it useful as an introductory survey of the subject, more particularly on the theoretical side Each chapter has appended a number of problems to which the answers are given B C.

Riddles of the Gobi Desert By Sven Hedin Translated from the Swedish by Elizabeth Sprigge and Claude Napier Pp x+382+24 plates. (London George Routledge and Sons, Ltd., 1933) 18*s* net

IN this volume, the narrative of the Sino-Swedish expedition to the Gobi Desert, which was at work continuously from 1927 until 1933, carries the story on for a further period of two years It resumes with the author's return journey to Sinkiang from Sweden in 1928, and closes with reports covering the work of exploration up to the end of 1929 As the author was busily engaged in the administrative work of the expedition in China, and was further distracted by a journey to the United States, which was extended to Sweden, on account of his health, he was unable to take the field in person, and his detail is necessarily drawn from the reports of his colleagues His narrative is none the less absorbing and, when he is dealing with the incidents of his own journeys, is vivid in its sketches of persons and events

The closing chapters of the book embody the individual reports of members of the expedition on the different departments of investigation, meteorology, palæontology, geography, archæology, etc. Although of a preliminary character only, they are sufficiently full to indicate the importance of the material obtained Further detail, especially that relating to the neolithic civilisation of the desert and the painted pottery resembling that from Honan, will be awaited with interest A chapter added after the publication of the Swedish edition of the book records the discovery of the new Lop Nor in 1931

Much of the narrative is occupied with the difficulties encountered by the expedition in its relations with Chinese provincial officials At Peking and Nanking, all, from President downward, were most cordial and the whole learned and official world co-operated to promote the success of the expedition in every way

(1) *Intelligence and Intelligence Tests* By Rex Knight (Methuen's Monographs on Philosophy and Psychology) Pp ix+98 (London Methuen and Co , Ltd , 1933) 2*s* 6*d* net

(2) *Psychology and the Choice of a Career* By Dr F M Earle (Methuen's Monographs on Philosophy and Psychology) Pp vii+103 (London Methuen and Co , Ltd , 1933) 2*s* 6*d* net

THE purpose of the series of monographs to which these two books belong is the entirely commendable one of setting forth, for the benefit of the general reader, and with a practical end in view, the results of some of the best recent work in the fields of psychology and philosophy This purpose is well achieved in both of these two members of the series In each case the problem is a very practical one, and in each case the author manages to show, simply but without any sacrifice of accuracy, how scientific method is contributing towards its solution

(1) Mr Rex Knight gives a clear and concise account of intelligence tests, and of their use in diagnosing mental deficiency, in the grading of pupils, in the study of difficult children, and in vocational guidance and selection

(2) In Dr Earle's book the general principles of vocational guidance, so far as they have yet been discovered, are systematically stated In such guidance, as the author shows, not only the psychologist, but also the parent, the doctor, the teacher, and the employment officer, each has a part to play

Both these introductory manuals are fittingly equipped with brief but sufficient advice as to further reading

Textile Electrification · a Treatise on the Application of Electricity in Textile Factories By Dr Wilhelm Stiel Authorized translation by A F Rodger Pp xix+608+6 plates (London . George Routledge and Sons, Ltd , 1933) 63*s* net

THE textile industry has probably gone further than any other industry in replacing handicraft by machine production The transition took place in the first half of the nineteenth century concurrently with the introduction of steam power. This led inevitably to displacing the cottage industry (spinning wheel and hand-loom) by large mills So successful was the use of steam power and line shaft driving that manufacturers were loath to change to electric power and individual drive In the development of individual driving by electric motors, Germany has played the leading part This has opened up new prospects for small textile undertakings. It looks as if it might revive the cottage industry As the English-speaking countries possess more than half the world's cotton spindles, the importance of spinning and weaving to Great Britain justifies the translation of this standard work into English The book is thoroughly practical and can be warmly recommended to everyone connected with the textile industry

Our Forefathers, the Gothonic Nations a Manual of the Ethnography of the Gothic, German, Dutch, Anglo-Saxon, Frisian and Scandinavian Peoples By Dr Gudmund Schutte Vol 2 Pp xvi+483+20 plates (Cambridge . At the University Press, 1933) 30*s* net

IN the second volume of "Our Forefathers", Prof Schutte, having already in his first volume disposed of general questions relating to the Indo-Germanic peoples, passes on to deal with individual 'Gothonic' groups Each is taken in turn and its early history reviewed in the light of the evidence of literary records, philology, place-names, tradition, archæology and ethnology The Anglo-Saxons and the Scandinavian peoples, naturally, receive extended treatment

Prof Schütte has had the advantage of the assistance of specialists, but where this has been unobtainable, his own critical examination of the evidence and his suggestions in dealing with controversial points are both acute and stimulating His book will be invaluable for reference purposes in the study of the early history of the European peoples, pending the production of the detailed ethnology to which he regards his own work as merely preliminary

Phytopathological and Botanical Research Methods By Prof T E Rawlins Pp ix+156 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd., 1933) 15*s* 6*d*. net

THE rapid development of plant pathological investigations, and the increasing use of microchemical methods, have created a need for a survey of the various microscopic and culture methods adopted by workers in these subjects.

Considerable experimental work was done before publication, and many of the methods described are new, while others demonstrate improved technique Though primarily intended for phytopathologists, workers in other fields should find much useful information. A short, but suggestive, chapter is given on the interpretation of experimental results, and an important section of the book is the bibliography, with nearly one thousand references covering a wide field of investigation.

Mendeléeff (1834–1907) and the Periodic Law

DMITRI IVANOWITSCH MENDELÉEFF, who was born on February 7, 1834 (N S) and was for many years professor of chemistry at Leningrad, is chiefly remembered for the first clear and satisfactory enunciation of the Periodic Law, the discovery having been made in the latter part of the year 1868 and announced in 1869 He found that when the chemical elements are set out in an unbroken row in the order of the atomic weights, certain breaks become apparent, and the whole range divides itself into groups of related elements This result, expressed in the law that "the properties of the elements are in periodic dependence on the atomic weights" is the basis of the Periodic System, or Periodic Table In arriving at this conclusion, Mendeléeff was influenced mainly by the previous attempts at classification made by Dumas, Lenssen, Pettenkofer and Kremers, especially the first two, those of Newlands in 1863, and of others, being unknown to him A similar result had been achieved by Lothar Meyer in 1868, but was not published

A German abstract of Mendeléeff's discovery, containing all the essential features, appeared in 1869, in which year it was thus generally known in Europe, and a long paper of 1871 gave a table which is essentially in its modern form These publications attracted very little attention, but the interest of chemists was aroused by the discovery, in 1875 and 1879, respectively, of the elements gallium and scandium, which were found to have the properties predicted for the missing elements which Mendeléeff had called ekaaluminium and ekaboron, places for them being reserved in the table. The element germanium, discovered in 1866, was also recognised as the ekasilicon of Mendeléeff These discoveries made it clear that the Periodic Law was a fundamental truth, and the further progress of research has emphasised more and more its supreme importance in the study of the elements

The discovery of argon was an indication to Ramsay that a new group of elements of zero valency must be added to the table, and the elements helium, neon, krypton and xenon were before long added to the group, and the last member is the radioactive emanation The suggestions of Mendeléeff that this group also contained two other elements, one being the ether, of very small atomic weight, and the other an unknown element of atomic weight less than 0 4, and that there was a missing element of the halogen group, of atomic weight 3, have appeared inconsistent with modern views of the structure of the atomic nucleus.

The regularities among the atomic weights of the elements as disclosed in the Periodic System could not fail to revive speculations about a primary matter, which had attracted chemists since Prout had suggested that this primary matter was hydrogen. Mendeléeff was entirely opposed to this hypothesis of primary matter The difficulty of fractional atomic weights was removed by the discovery that many elements are mixtures of isotopes, and the investigations on atomic structure showed that the Periodic Law is a consequence of the formation of atoms from protons and electrons This recognition of isotopes also removed the objection that some pairs of elements, such as iodine and tellurium, were apparently placed in the wrong order in the table on the basis of their atomic weights, their true positions never being in doubt The discovery that the position of an element in the table is really conditioned by its atomic number, or the positive charge on the atomic nucleus, gave the Periodic Law a fundamental character, and the theory of atomic disintegration enabled all the newly discovered radioactive elements to find their places in the lower part of the table, in many cases a single place containing several isotopes of the same atomic number.

An outstanding difficulty was the position of the elements of the rare earths After lanthanum and cerium came a large number, not definitely known, of elements of very closely related properties, clearly belonging to the same group After these came the element tantalum, obviously in the fifth group For many years the rare earth element cerium, which *forms* very stable compounds in which it is quadrivalent, was considered to be the fourth group element of the rare earths This difficulty was overcome on the basis of the theory of atomic structure by Bohr The pronounced tervalent character of the rare earth elements, preserved with steadily increasing atomic weight, was shown to be a consequence of the presence in their atoms of incompleted inner electron levels, the filling up of which, by successive additions of electrons to keep step with the increasing nuclear charge, left unchanged the outer valency electrons. The atomic numbers of the rare earths were also determined by X-ray spectroscopy, and a knowledge of these, together with the information on the numbers of electrons in completed groups which resulted from general atomic theory, showed that an unknown element of the fourth group must come before tantalum This element was shortly afterwards discovered in hafnium There was also, it was clear, an earlier unknown element in the rare earth group, which has been found in illinium. The group of rare earths was then known to be complete

The Periodic Law has thus assisted very materially in promoting discovery and has shown itself to be a truth of great extension and depth Mendeléeff himself said. "I have never once doubted the universality of this law, because it could not possibly be the result of chance" It is, in fact, the great guiding principle in the study of the structure of the atom

The Ether-Drift Experiment and the Determination of the Absolute Motion of the Earth*

By Prof Dayton C Miller, Case School of Applied Science, Cleveland, Ohio

THE ether-drift experiment first suggested by Maxwell in 1878 and made possible by Michelson's invention of the interferometer in 1881, though suitable for the detection of the general absolute motion of the earth, was actually applied for detecting only the known orbital component of the earth's motion For the first time, in 1925 and 1926, I made observations at Mount Wilson of such extent and completeness that they were sufficient for the determination of the absolute motion of the earth These observations involved the making of about 200,000 single readings of the position of the interference fringes

The ether-drift observable in the interferometer, as is well known, is a second order effect, and the observations correctly define the line in which the absolute motion takes place, but they do not determine whether the motion in this line is positive or negative in direction

At the Kansas City meeting of the American Association for the Advancement of Science, in December, 1925, before the completion of the Mount Wilson observations, a report was made showing that the experiment gives evidence of a cosmic motion of the solar system, directed towards a northern apex, but the effects of the orbital motion were not found, though it seemed that the observations should have been quite sufficient for this purpose[1]

The studies of the proper motions and of the motions in the line of sight of the stars in our galaxy have shown that the solar system is moving, *with respect to our own cluster*, in the general direction of a northern apex in the constellation Hercules This apex is near that indicated by the ether-drift observations as just reported, and seemed to be confirmatory evidence of its correctness Probably it was this that caused the continuation of the analysis of the problem, *on the supposition that the absolute motion was* to the northward in the indicated line All possible combinations and adjustments failed to reconcile the computed effects of combined orbital and cosmic motions with the observed facts

In the autumn of 1932, a re-analysis of the problem was made, based upon the alternative possibility that the motion of the solar system is in the cosmic line previously determined, but is in the opposite direction, being directed southward This gives wholly consistent results, leading for the first time to a definite quantitative determination of the absolute motion of the solar system, and also to a positive detection of the effect of the motion of the earth in its orbit

The absolute motion of the earth may be presumed *to be the resultant of two independent* component motions One of these is the orbital motion around the sun, which is known both as to magnitude and direction. For the purposes of this study, the velocity of the orbital motion is taken as 30 kilometres per second, and the direction changes continuously through the year, at all times being tangential to the orbit The second component is the cosmical motion of the sun and the solar system Presumably this is constant in both direction and magnitude, but neither the direction nor magnitude is known, the determination of these quantities is the particular object of this experiment The rotation of the earth on its axis produces a velocity of less than four tenths of a kilometre per second in the latitude of observation and is negligible so far as the velocity of absolute motion is concerned, but this rotation has an important effect upon the apparent direction of the motion and is an essential factor in the solution of the problem Since the orbital component is continually changing in direction, the general solution is difficult, but by observing the resultant motion when the earth is in different parts of its orbit, a solution by trial is practicable For this purpose it is necessary to determine the *variations* in the magnitude and in the direction of the ether-drift effect throughout a period of twenty-four hours and at three or more epochs of the year The observations made at Mount Wilson correspond to the epochs April 1, August 1 and September 15, 1925, and February 8, 1926

The point on the celestial sphere towards which the earth is moving because of its absolute motion is called the apex of its motion This point is defined by its right ascension and declination, as is a star, and the formulæ of practical astronomy are directly applicable to its determination from the interferometer observations The theoretical consideration of the determination of the apex of the motion of the earth has been given in a paper by Prof J J Nassau and Prof P M Morse[2]

Table 1 gives the right ascensions and declinations of the apexes of the earth's cosmical motion as obtained from the interferometer observations for the four epochs on the presumption of a southward motion, together with the right ascensions and declinations calculated upon the theory of an ether-drift

Table 1 Location of resultant apexes

Epoch	α (Obs)	α (Calc)	δ (Obs)	(Calc)
Feb 8	6^h 0^m	5^h 40^m	−77° 27′	−78° 25′
April 1	3 42	4 0	76 48	77 50
Aug 1	3 57	4 10	64 47	63 30
Sept 15	5 5	5 0	62 4	62 15

Apex of cosmic component $\alpha = 4^h\ 56^m$, $\delta = -70°\ 33'$

From these resultant apexes are determined four values for the apex of the cosmic component, which is the apex of the motion of the solar system as a whole. This apex has the right ascension $4^h 56^m$ and the declination 70° 33′ south

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* Paper read before Section A (Mathematical and Physical Sciences) of the British Association meeting at Leicester on September 13, 1933

Continuing the astronomical description, having found the elements of the 'aberration orbit', these are used to compute the apparent places of the resultant apexes for the four epochs of observation. On the accompanying chart of the south circumpolar region of the celestial sphere (Fig 1), the large star indicates the apex of the cosmic motion, and the four circles show the locations of the calculated apexes These apexes necessarily lie on the closed curve representing the calculated aberration orbit, the centre of which is the apex of the cosmic component of the earth's motion Thus aberration orbit is the projection of the earth's orbit on the celestial sphere, which in this case is approximately a circle The observed apexes for the four epochs are represented by the small stars The locations of the pole of the ecliptic and of the star Canopus are also shown. The close agreement between the calculated and observed apparent apexes would seem to be conclusive evidence of the validity of the solution of the ether-drift observations for the absolute motion of the earth and also for the effect of the orbital motion of the earth, which hitherto has not been demonstrated

It may seem surprising that such close agreement between observed and calculated places can be obtained from observations of such minute effects, and effects which are reputed to be of such difficulty and uncertainty Perhaps an explanation is the fact that the star representing the final result for the February epoch is, in effect, the average of 8,080 single determinations of its location , the star for the August epoch represents 7,680 single determinations, that for September, 6,640, and that for April, 3,208 determinations

The location of the apex of the solar motion is in the southern constellation Dorado, the Sword-Fish, and is about 20° south of the star Canopus, the second brightest star in the heavens It is in the midst of the famous Great Magellanic Cloud of stars The apex is about 7° from the pole of the ecliptic and only 6° from the pole of the invariable plane of the solar system ; thus the indicated motion of the solar system is almost perpendicular to the invariable plane This suggests that the solar system might be thought of as a dynamic disc which is being pulled through a resisting medium and therefore sets itself perpendicular to the line of motion.

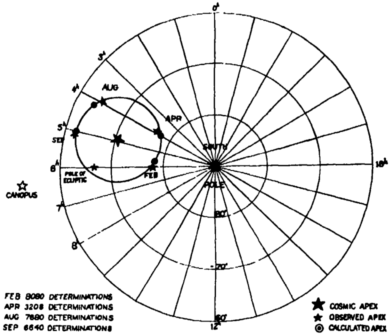

FIG 1 Observed and calculated apexes of the absolute motion of the solar system

It is presumed that the earth's motion in space is projected on to the plane of the interferometer, and the *direction* of this motion is determined by observing the variations produced in the projected component by the rotation of the earth on its axis and by the revolution around the sun Both the magnitude and the direction of the observed effect vary in the manner and in the proportion required by an ether-drift, on the assumption of a stagnant ether which is undisturbed by the motion of the earth through it But the observed *magnitude* of the effect has always been less than was to be expected, indicating a reduced velocity of relative motion, as though the ether through which the interferometer is being carried by the earth's motion were not absolutely at rest The orbital velocity of the earth being known, 30 kilometres per second, the cosmical velocity of the solar system, determined from the proportional variations in the observed effects, is found to be 208 kilometres per second

Table II gives the observed periodic displacement of the fringe system as the interferometer rotates on its axis, and the corresponding velocity of relative motion of the earth and ether

Table II Displacements and velocities

Epoch	Fringe Shift	Velocity (Obs)	Velocity (Calc.)
Feb 8	0 104 l	9 3 km /sec	195 2 km /sec
April 1	0 123	10 1	198 2
Aug 1	0 152	11 2	211 5
Sept 15	0 110	9 6	207 5

The last column gives the velocity to be expected in the stagnant ether theory on the presumption that the cosmic component and the orbital component are both reduced in the same proportion in the interferometer. The mean factor of reduction is $k=0\cdot0514$ The azimuth of the observed effect is subject to a diurnal variation, produced by the rotation of the earth on its axis The observed oscillations of the azimuth are in accordance with theory as to magnitude and time of occurrence, but for some unexplained reason, the axis of the oscillations is displaced from the meridian. In order to account for the results here presented, it seems necessary to accept the reality of a modified Lorentz-FitzGerald contraction, or to postulate a viscous or dragged ether as proposed by Stokes.

The results here reported are, notwithstanding a common belief to the contrary, fully in accordance with the original observations of Michelson and Morley of 1887, and with those of Morley and Miller of 1904–5 The history of the ether-drift experiment and a description of the method of using the interferometer, together with a full account of the observations and their reduction, has been published elsewhere[3].

[1] *Science*, 63, 433, 1926 NATURE, 116, 49, 1925

[2] *Astrophys J*, March, 1927

[3] *Rev. Mod Phys*, 5, 203, July, 1933

Treasures of Carniola*

By CHRISTOPHER HAWKES, British Museum

THE work which has given this brief essay its inspiration and its title stands for three things of outstanding importance to all interested in the application of science to human history First, the unique value of the prehistoric treasures of Carniola and the surrounding provinces themselves, both in the narrower world of archæology and the broader one of man's history at large Second, the devotion by the late Duchess of Mecklenburg of her great resources to their methodical excavation from 1905 to 1914, after the district had for many decades been pillaged by indiscriminate fossickers, and so amassing a collection not only of enormous wealth, but also of unspotted scientific purity Third, the unparalleled feat of co-operation by which an American sale-room, acting for the late Duchess's daughter, has commissioned an international committee of prehistorians to work over the entire collection and perpetuate its authentic archæological groupings as lots in a free public sale in New York, at which it has been laid down that each lot is accompanied by its original inventory, excavation-records, plans, and other documents, the publication rights in each being reserved solely to its purchasers The volume now before us is the catalogue which embodies the archæological committee's work, and in enabling its publication the American Art Association Anderson Galleries have caused an outstanding contribution to be made to prehistoric science

The sale took place on January 26, and its results are still unknown to us It is evident that much of the collection will never re-cross the Atlantic, and it is known that of the European countries whose national museums may be enriched by shares, Great Britain has decided not to be one. But it is to be hoped that the purchasers, whatever their nationalities, will faithfully discharge their manifest obligation to publish their lots, with their documentation behind them, in detail and without delay The Mecklenburg sale may thus become an international precedent of the first importance in many scientific spheres.

The Duchess of Mecklenburg was born Princess of Windischgrätz, and came of a family long distinguished for services to archæology no less than to the Austro-Hungarian crown. By the greatest good fortune, their oldest estates in Carniola and Styria coincided with one of the richest and most important archæological centres in Europe She deserved well of her heritage. For it is safe to say that her excavations form one of the greatest single contributions ever made to the early history of man in this Continent How this is so is ably expounded in the long introduction to the catalogue by Dr. Adolf Mahr, who, it is needless to say, went to his present post in Dublin from Vienna.

The Early Bronze Age saw the birth of a round half-dozen of great cultural groupings in Europe, growing up in the earlier centuries of the second millennium B C Of these, Minoan civilisation dominated the Ægean from Crete Italy received a Bronze Age culture linked through the Alpine lakes with the barrow-builders of west-central Europe; and north and east of these three a civilisation of many provinces but a single broadly-conceived character stretched from the Balkan and Dinaric mountains to Saxony and Silesia. Equilibrium at last grew into tension, and rather before 1000 B C the tension snapped. The aspect of Europe was in a short time transformed The Minoan-Mycenæan civilisation crumbled to its downfall, accompanying upheaval in the Near East and all over south-eastern Europe The Etruscans thereafter left Asia Minor for Italy, to lay the foundations of its future, while from the great East European culture-area beyond the mountains migrating tribes had come pouring out, pressing into the Balkan highlands, and down to the Ægean, debouching on to the head of the Adriatic, penetrating the Swiss and south German plains and valleys, and absorbing their peoples in a varied but essential continuum reaching to

* Treasures of Carniola Prehistoric Grave Material from Carniola Excavated in 1905–14 by H H the late Duchess Paul Friedrich of Mecklenburg (*née* Princess Marie of Windischgrätz) Sold by Order of her Daughter, H H the Duchess Marie Antoinette of Mecklenburg Catalogue compiled under the direction of Dr Adolf Mahr (Dublin), assisted by Prof Raymond Lantier (St. Germain), Dr Gero von Merhart (Marburg a d L), Mr J M de Navarro (Cambridge), Prof Balduin Saria (Ljubljana), Prof Ferenc de Tompa (Budapest), Dr Emil Vogt (Zurich) and others Pp x+131+33 plates (New York American Art Association, 1934)

France and the British Isles. Meanwhile, from the south-east or east, there came into Europe the knowledge of iron.

The Early Iron Age that followed is the dawn of European history. The culture with which these great movements led it to open is round the Ægean called the Geometric, in Italy the Villanovan and Etruscan, and northwards of these the Hallstatt culture, from the great cemetery site in Upper Austria where it was first recognised, and where the Duchess of Mecklenburg in her turn came to excavate East of the central Alps, the peoples of the Hallstatt culture were predominantly Illyrians These Illyrians lay open to the east whence were coming the Scyths, they stretched down the Balkan Peninsula to the confines of Greece, they marched beyond the head of the Adriatic with Villanovan and Etruscan Italy, and to the north-west they mingled with the future Celts

Carniola, where the routes from Greece and Italy meet, with the ways east and north and west lying open behind, is the key to the whole great nexus Here, in cemetery after cemetery of surpassing richness, we can trace the development and appraise the character of the Hallstatt civilisation as never before, in the Duchess's great collection. It would be impossible to go into details here the total number of excavated graves is estimated at more than 1,300, and a reckoning of 20,000 individual objects may be short of the truth But if this mass of material, scientifically interpreted, helps us to understand the Hallstatt civilisation at its focal point, it opens our eyes to the unity of a great stretch of human history For, linked as it was to Etruscan Italy and Geometric Greece, with the shadow of the old Mycenæan Empire behind them, the Hallstatt civilisation was spread out over barbarian Europe, to give birth to that of the Celts whose conquests in east and west made way for the Roman Empire, and to last on meanwhile in Carniola, and more strongly still in the lands to south-eastward, until it passed under that Empire itself Standing here now, we can at once salute the spirit of Augustus and invoke the ghost of Agamemnon

Obituary

PROF J COSSAR EWART, F.R S

THE death of Prof James Cossar Ewart removes one who worked with distinction for more than half a century in the field of zoology and was a pioneer in the study of hybridisation and other problems of animal breeding

Prof Ewart was born at Penycuik, Midlothian, in 1851 and in 1871 entered the University of Edinburgh as a medical student After graduating in 1874 he acted for six months as demonstrator of anatomy under Turner and was then appointed curator of the Zoological Museum in University College, London. Besides adding numerous preparations both of vertebrates and invertebrates to the collection, he assisted Lankester, who had been appointed professor in University College in 1874, to organise the first course of practical zoology in the College, and in the absence of his chief in the summer of 1878 he was in charge of this class. During this period Ewart published papers on the structure of the lens and retina, on points in the anatomy of the lamprey and on the life-history of lower organisms, including *Bacillus anthracis*, and for this last work, presented as a thesis for the degree of M D (Edin), he was awarded a gold medal

At the end of the summer term of 1878 Ewart returned to Edinburgh and became a lecturer in anatomy in the extra-mural School of Medicine, but after about two months in this office he was appointed professor of natural history in the University of Aberdeen and began his work there in January 1879. In the same year he established a small marine zoological station near Aberdeen—the first marine laboratory in Britain—in which he and others conducted investigations during the next three years The most notable product of the station was the material for the Croonian lecture of 1881, by Ewart and Romanes, on the locomotor system of echinoderms

After three active years in Aberdeen, Ewart was appointed, in succession to Wyville Thomson, to the chair of natural history in Edinburgh, which he held for forty-five years—1882–1927 He reorganised the class of practical zoology, hitherto optional and attended by only a small proportion of the students, and established a more advanced practical course for students who were specially interested in zoology. He further developed the teaching and research in his Department by the institution of lectureships in embryology (in 1885, held first by George Brook and afterwards for twenty-six years by John Beard), in invertebrate zoology (1901) and in heredity and genetics (1910, to which Arthur Darbishire was appointed).

In 1882 Ewart became scientific member of the Fishery Board for Scotland, and during the next seven years was the author or joint author of about a dozen papers and reports on fisheries subjects including the natural history of the herring. Then followed the series of well-known papers, from 1888 until 1895, on the electric organ of the skate (*Raia*) and on the cranial nerves and lateral sense organs of this fish and *Læmargus*. He showed that the electric organ of the skate, discovered by Dr. James Stark of Edinburgh in 1844, was a developing and not a degenerating structure, and that in its most primitive condition, as seen in *Raia radiata*, the muscle fibres from which the electric elements are formed are less modified than in other species, and that in *Raia batis* the modification has proceeded so far that the adult electric organ presents little trace of its relation to muscular tissue

Ewart's investigations on the cranial nerves were undertaken at a time of considerable activity in neurological research and "trusting mainly to the old methods of the comparative anatomist" he gave an accurate account of the lateral sense organs and their nerve supply and of the macroscopic anatomy of the cranial nerves of *Læmargus* and, with J. C. Mitchell, of *Raia*. He had further preparations made for continuing his work on the cranial nerves, but was diverted by his interests in the development of the limbs of the horse. He showed in 1894 that in fœtal horses a digit composed of three phalanges was borne on the distal end of each of the splint bones which represent the metacarpals and metatarsals of the second and fourth digits, but that about the time of birth the phalangeal joints disappear, the phalanges become ossified and, early in the second year, fuse with their respective splints forming the "buttons". This was an important and interesting contribution in view of the reduction of these digits known to have occurred in the evolution of the limbs of the horse.

About 1895 Ewart began his work in animal breeding. It is to be remembered that Mendel's laws were not rediscovered until 1900, but Ewart devised careful experiments to throw light on some of the problems of cross breeding and inbreeding, on reversion and on telegony. The best known of these investigations were those in which mares of various breeds were crossed with a Burchell's zebra stallion. Ewart thoroughly studied the hybrids and presented the results, together with those of many other breeding experiments in a volume, "The Penycuik Experiments" (1899), which attracted much attention. The zebra hybrids formed an interesting exhibit at the Royal Agricultural Society's Show in York in 1900. His investigations to test the theory of telegony—that a sire may 'infect' the dam served by him and leave his mark on her subsequent offspring by other sires—led him to a negative result, and he showed that the appearances described could be explained as examples of reversion.

Several papers followed on different subspecies of horses, and on the origin and evolution of horses and ponies, and Ewart described (1906) the animal remains, more particularly of a considerable number of horses, found in the Roman fort at Newstead near Melrose. Papers on domestic sheep and their wild ancestors marked a further development of Ewart's work, and the renting from 1913 until 1921 by the University of Edinburgh of a farm at Fairslacks enabled him to conduct investigations for the improvement of the fleece of sheep, which brought him into contact with the woollen industry in Scotland; he also became an active member of the Council of the Wool Industries Research Association in Leeds. Ewart's expert knowledge was the chief factor which decided the Board of Agriculture for Scotland to constitute in Edinburgh in 1913 a committee on animal breeding. This committee was suspended during the War but was re-established in 1919 and in 1920 appointed Dr. (now Prof.) F. A. E. Crew as director of research, under whom the work in genetics and animal breeding has developed into a separate Department of the University.

The rearing of penguins in the Zoological Park in Edinburgh afforded Ewart the opportunity to study the sequence and the structure of the different types of feathers. In a paper in 1921 he discussed the origin and history of feathers, and he continued until about two years ago to devote attention to the relationship of feathers and scales.

Ewart had skilful hands and could make a good dissection and admirable drawings; early examples of his drawings are to be found in the plates of Turner's lectures on the placenta (1876). He was elected F.R.S. in 1893, was awarded the Neill Medal and Prize of the Royal Society of Edinburgh in 1898 in recognition of his investigations on telegony, and in 1928 received the honorary degree of LL.D. from his old University. He retired from his chair in 1927 and died in Penycuik on December 31, 1933. He is survived by his widow, a married daughter and a son, who is a surgeon in London. J. H. A.

DR. F. H. H. GUILLEMARD

FRANCIS HENRY HILL GUILLEMARD, whose death occurred on December 23, was born at Eltham in 1852. Travel and natural history made a strong appeal to him from boyhood onwards. At an early age he announced his intention of becoming a traveller and a doctor, and his first published work was an article on "Pigeons" in the *Boys' Weekly* in 1866. Destined for Rugby, he was kept at home between 1866 and 1868 owing to ill-health and afterwards went to a 'crammer' at Richmond. By this time he had become an habitué of Stevens' rooms in King Street, Covent Garden, never missing a natural history sale if he could help it and seeing there the great ornithologists of the day—Newton, Lilford, Howard Saunders and others. In 1870 he went up to Gonville and Caius College, Cambridge, where he read medicine under Humphry and Paget.

As an undergraduate, Guillemard made two journeys to the Orkneys, chiefly for bird study, which was one of the ruling passions of his life, and immediately after he had taken his degree he made a more ambitious trip to Lapland. At St. Bartholomew's Hospital he was clinical clerk to Patrick Black at the time when Robert Bridges was house physician.

Taking his M.B. degree in 1876, Guillemard entertained no thoughts of medical practice. Travel was his objective, and in 1877 he had the opportunity of exploring some little-known parts of Africa, trekking across the Transvaal and the Orange Free State in the old bullock-wagon manner and visiting the diamond fields in their early days. His articles on the ornithology of South Africa were published in the *Field* in 1880 and 1881, and the journey also provided the subject for his M.D. thesis, "On the Endemic

Hæmaturia of Hot Climates caused by the Presence of *Bilharzia Hæmatobia*", which was published in 1882. Guillemard's most famous journey was begun in 1881 when the *Marchesa* (schooner yacht of 420 tons, Mr C T. Kettlewell captain and owner) was commissioned The *Marchesa* reached Colombo in April 1882; from there she sailed to Singapore, Formosa, the Liu-kiu Islands, Japan, Kamschatka, the Sulu Archipelago, North Borneo and New Guinea. From the Malay and Papuan regions the *Marchesa* brought home a large collection of natural history objects, most of them obtained in the large islands of north-west New Guinea In particular, Guillemard was a passionate enthusiast for the birds of paradise, of which seventeen different species were found The whole collection of birds, numbering about 3,000 specimens, was described by Guillemard in the *Proceedings of the Zoological Society* of 1885, and on his return to England he settled in Cambridge with the view of writing a complete account of his journey "The Cruise of the *Marchesa*" was published in 1886 and was hailed as one of the best travel books in many years, such passages as that describing the first view of the Kamschatka group of volcanoes have made a permanent place for themselves in the literature of travel

Guillemard became a member of the British Ornithological Union in 1885 and, at the suggestion of Lord Lilford, went to Cyprus to make a study of the ornithology of the island Returning to Cambridge, he was the first holder of the lectureship in geography in the University, but owing to ill-health resigned the post almost immediately. A few years later, Guillemard settled at the Old Mill House at Trumpington, and there he lived until his death Though he held no official post in the University, he was one of its best known figures he was the general editor of the Cambridge Geographical Series and of the Cambridge County Geographies published by the University Press, he wrote the life of Magellan and the volume on Malaysia and the Pacific Archipelago in Stanford's "Compendium of Geography", he was active on the Botanic Garden and Fitzwilliam Museum Syndicates Above all, he had a wide circle of friends from whom he won affection as well as admiration With the passing of Henry Guillemard, Cambridge loses something that was exquisite and unique

WE regret to announce the following deaths

Dr D H Scott, F R S, honorary keeper of the Jodrell Laboratory at Kew in 1892–1906 and foreign secretary of the Royal Society in 1912–16, a leading authority on palæobotany, on January 29, aged seventy-nine years

Dr Henry S Washington, petrologist in the Carnegie Institution of Washington since 1912, an authority on the composition and classification of rocks, especially igneous rocks, on January 7, aged sixty-seven years.

Mr Edgar Worthington, formerly secretary of the Institution of Mechanical Engineers, on January 23, aged seventy-seven years

News and Views

Micro-ray Radio Link across the English Channel

ANOTHER milestone in the history of practical radio communication was reached on Friday, January 26, when Sir Philip Sassoon, Under-Secretary of State for Air, officially opened the world's first commercial 'micro-ray' radio service on a wavelength of 17 cm between the civil airports at Lympne, Kent, and St Inglevert, France. M. Delesalle, Under-Secretary of State for Air in France, was present at St Inglevert, and messages of greeting were exchanged, both by teleprinter and by telephone The inauguration of this service is the outcome of a demonstration given in March 1931 by Messrs. Standard Telephones and Cables, Ltd, who secured the contract for the Lympne installation from the Air Ministry The corresponding station in France was erected by the associated company—Le Matériel Télephonique, of Paris The actual wave-lengths employed in this radio link are 17 cm in one direction and 17 5 cm. in the opposite direction, and this separation enables duplex working to take place simultaneously by teleprinter and telephone. The teleprinter has been used on land-line commercial telegraph services for some years, and its application to radio communication on this occasion will enable messages to be sent and recorded at a speed of 60–70 words per minute

THE power generated at each transmitting station of new cross-Channel radio link is less than one watt, a special valve being employed to produce the requisite high-frequency oscillations, which are fed into an aerial about one inch long This aerial is situated at the focus of a small concave reflector which directs the waves on to a second reflector approximately 10 feet in diameter. The concentrated beam emanating from this arrangement is directed to the similar reflector system used for reception at the distant station. At the Lympne aerodrome, the aerial and reflectors are erected on the roof of a hangar, and are so placed as to command an optically clear path of the corresponding equipment installed on steel towers at St. Inglevert, 35 miles away. Duplicate aerial and reflector systems are employed for transmission and reception Special feeder lines are led down to the transmitting and receiving apparatus installed in the buildings below. This apparatus provides for the use of telegraphy and telephony in addition to the normal service to be carried on by means of Creed teleprinters. The object of this new radio service is to speed up the transmission of essential traffic messages, meteorological reports, and so on, involved in the operation of the cross-Channel air routes, and on account of its freedom from interference and its immunity from the effect of weather conditions, the service is likely to be highly successful and to add materially to the safety of air-travel between England and France

Gas Warfare and Civilian Populations

Dr. F. A. Freeth, of Imperial Chemical Industries, Ltd, addressing a meeting of the City of London Branch of the League of Nations Union on January 26, made some caustic comments on the subject of the position of the civilian population in chemical warfare The topic of chemical warfare has been so forced on the attention of the populace, he said, that the main danger in case of such an attack would be a psychological one Every chemical industry necessarily uses various kinds of poisonous materials, gaseous and otherwise, in its processes, but as a menace to the civilian population, they are not worth considering The really 'killing' gases are of low density and in consequence quickly disperse in the atmosphere As examples, Dr Freeth mentioned hydrocyanic acid and carbon monoxide, both of which are particularly subtle poisons Now the exhaust of an idling motor-bus contains about 6 per cent of carbon monoxide and, in consequence, the atmosphere of a narrow thoroughfare like Bond Street in London must, during a busy time, contain considerable quantities of the gas Yet owing to the ventilation provided by the air, it is not allowed to accumulate Of the heavier gases used in warfare, Dr Freeth mentioned chlorine, which requires for its use a quiet atmosphere and a gentle breeze in the desired direction, and mustard gas, which does not spread rapidly and on wet porous soils decomposes. The percentage of deaths to casualties from mustard gas during the War was less than four If during a gas raid, a man was able to keep his head sufficiently to shut all the windows of his house and put out the fires, he would be able to wait, in reasonable safety apart from a direct hit, until the authorities had dispersed the gas

Geography and World Citizenship

The Education Committee of the League of Nations Union has been meeting for some years and initiating and advising methods for making international questions and an international spirit a more integral part of ordinary school and college work It is largely through the activity of this committee that teachers as a profession stand so firmly by the League of Nations Meetings and conferences are arranged, lecturers sent out and publications of various kinds issued from time to time Of the latter, a brochure has just appeared (to be obtained from 15, Grosvenor Crescent, S W 1, price *4d.*) on "Geography Teaching in relation to World Citizenship". It is edited by Prof. J. F. Unstead with the help of a number of London teachers of geography and others, and will be approved by all engaged in similar work. The subject has always been regarded in schools as more obviously international than history, and for that reason much of what is said in the pamphlet will appear somewhat commonplace But there is no objection to enforcing emphatically some of the great commonplaces of human life and thought. It is useful to have set out clearly and in sufficient detail (as here) the main aspect of the inter-relationship of land and people and of the various peoples among themselves throughout the world.

The attitude of the various contributors to this pamphlet is sane and well-balanced, and they lay stress on those points in their theme which call for most emphasis at the present time Thus in relation to the mixture of races, it is pointed out that all over Europe—in Germany as well as elsewhere—there has been a blending of stocks, a 'give and take' in blood as well as in ideas But there is no attempt to pass over, or minimise, the reality or value of the contribution to the whole made by the various national units, based on a definite territorial region. The summary, for example, given of a supposed complete answer to the question, 'What should Italy imply to a well educated person ?', goes from an account of its physiography and natural products to its highest fruit in human genius—Dante, Leonardo, St Francis, Galileo and the rest The link is thus brought out between the teaching of geography and history, the more difficult subject It is understood that a further similar brochure will deal with history.

Lord Derby and the University of Liverpool

The completion by Lord Derby of twenty-five years as Chancellor of the University of Liverpool was celebrated on January 26 by a special congregation at which honorary degrees were conferred by the Chancellor upon Lady Derby, Lord Halifax (Chancellor of the University of Oxford) and Mr. Stanley Baldwin (Chancellor of the University of Cambridge) Lord Halifax was unable to attend. Following an address by the Vice-Chancellor (Dr. H J W Hetherington) on the growth of the University and the close associations, so long maintained, between Lord Derby, his immediate predecessors, and the University, the graduans were presented by the Public Orator (Prof Lyon Blease) for the degree of Doctor of Laws Following the graduation, Mr. Baldwin addressed the congregation and conveyed the congratulations of the University of Cambridge to the University of Liverpool upon the occasion. As the "newest of Chancellors", Lord Halifax conveyed congratulations in writing to both the University and the Chancellor upon the silver wedding of their partnership. In the evening Lord Derby, Lady Derby, The Earl of Crawford and Balcarres, members of the Derby family and the civic heads of the City of Liverpool and Merseyside were the guests at a dinner given by the University Association.

Indian Earthquake of January 15

The India Office has issued a general survey of the effects of the earthquake. The number of lives lost would appear to be in the neighbourhood of six thousand. The destruction of houses is greatest in the towns of North Bihar and Monghyr, especially Darbhanga, Muzaffarpur and Motihari Outside the towns, the principal effects are broken and obliterated roads, the collapse of bridges, floods and great fissures in the ground, from which mud, sand and water have issued, covering fields and crops with a devastating slimy deposit. The central area contains more than 300 square miles under sugar-cane. Though much of this has been saved, nearly all the sugar-mills have been destroyed. The chief difficulties at present are the supply of drinking water and the prevention of epidemics in towns and villages

Palestinian Remains at the British Museum

THE next special exhibition of prehistoric material at the British Museum will be opened on February 5 and will remain open for two or three months Two cases at the head of the main staircase, in the Department of British and Mediæval Antiquities, will be devoted to a display of a typical series from stratified caves near Mount Carmel, where excavations have been carried out by the British School of Archæology in Jerusalem and the American School of Prehistoric Research, with Miss D A E Garrod as field-director. Skeletal remains of palæolithic man will be shown (*Palæanthropus palestinensis*), and a sequence of implements from an early phase of the Palæolithic to Mesolithic, the latter being known as Natufian A special feature of the excavations is the blend of St Acheul and Le Moustier elements for a period , and a long succession of Aurignac types gives place to the post-palæolithic with a different and peculiar fauna. The abundant yield is incidentally useful for its similarities and contrasts to the better-known European industries, and special interest is attached to the beginnings of agriculture in Palestine

Velocity of Light

As was to be expected, the announcement which appeared in the press last summer (NATURE, 130, 25, July 2 , 277, Aug 20, 1932) to the effect that the latest experiments indicated a periodic variation in the velocity of light, has been construed in the sense that some seasonal instrumental error was at work. Science Service now issues an official confirmation of this view, given by the Mount Wilson authorities The report adds that the best value for the velocity of light is now 299,774 km /sec and that further analysis is only likely to change the last figure by one or two units The present investigation of the velocity of light is being carried out by Pease and Pearson, who are continuing Michelson's work and using the well-known rotating mirror method. It will be remembered that when Michelson used long base lines between mountain peaks, he found that irregularities in atmospheric refraction—the astronomer's "bad seeing"—interfered with the definition of the reflected image. The base is now *in vacuo*, in a pipe line a mile in length. To obtain more accurate results, it would be necessary to build a more stable pipe line, use quartz mirrors and employ elaborate timing devices.

Projected Electric Railways in Palestine

IN the *Electrician* of January 5 a description is given of a projected railway system for Palestine radiating from Jerusalem. Four new lines will radiate from a terminus at Jerusalem located outside the city on the northern side and east of the Damascus Gate Possibly recent economic developments in the country, the most important of which is the new harbour at Haifa on the Mediterranean, has tended to emphasise the isolated position of Jerusalem so far as railway facilities are concerned The northern line is to be 67 miles long, starting from the Jerusalem terminus, going through the Jordan valley, where the line descends to 500 feet below the Mediterranean level, finally getting to Tul Keram Junction on the main Haifa-Cairo line The eastern line (55 miles) would run from the terminus, crossing the River Jordan, passing through the Kalaat ez Zerka Station on the Hejaz railway to Ammam, the capital of Transjordan and the headquarters of the British Government's High Commissioner The southern railway (50 miles) would run through Hebron to Beersheba Finally, there would be a line (18 miles) from Wadi Fara on the northern line through Jericho to the potash works on the shore of the Dead Sea It is proposed to build a power station and a reservoir in Transjordan and another on the eastern shore of the Dead Sea to provide the electric current for operating the four railways The latter station would be necessary if an extension railway to the Red Sea should materialise Some years ago this project was discussed, the terminals of the line being Haifa and the ancient port of Akaba on the Red Sea. This would place Jerusalem on a direct sea-to-sea railway from the Mediterranean to the Red Sea. Possibly it might revive the ancient and prosperous traffic route from the Red Sea to the Levant of the times of Solomon and the Romans

Transmission of Power by High Tension Direct Current

AT the second World Power Conference held at Berlin in 1930, much consideration was given to international schemes for transmitting large amounts of power by high tension direct current The most ambitious of these schemes was to transmit one million kilowatts from the western fiords of Norway at a pressure of 500 kilovolts across Sweden and Denmark to the industrial regions in Westphalia, Germany. The great advantage of utilising power from the western fiords is that a uniform output of power all the year round could be obtained. It was proposed that the line should pass through Göteborg and Copenhagen to Hamburg, small amounts of power being tapped off at the two former cities, but the great bulk being delivered to Hamburg for distribution in the German networks. In a paper read to the Institution of Electrical Engineers on January 18, H. Rissik discussed the engineering aspects of the problem. He pointed out that with the same overhead lines, much larger currents can be used with direct than with alternating currents and the difficulties of working are much less with the former than with the latter. On the other hand, the methods of converting alternating current into high voltage direct current are still in the experimental stage, at least when dealing with power in bulk Lord Kelvin was a great advocate for the transmission of electric power by direct current, and although most of the difficulties in working with alternating current have been overcome since his time, it is interesting to notice that several engineers still think that direct current will be used for transmission in the future

Data of Social and Economic Problems

In a recent number of *Planning* (16 Queen Anne's Gate, London, S W.1) attention is directed to the lack of necessary data on many urgent social and economic problems. A civilisation has grown up under industrialism which calls for enormous resources of knowledge in order to operate it without constant and painful breakdowns Yet we neither possess the required knowledge nor are we making at present any adequate effort to get it, although its provision offers no insuperable difficulties Our whole attitude towards the question is still coloured by the prejudices and assumptions of a pre-scientific and pre technical age. It has yet to be recognised that the same technique which has produced electricity, wireless, fertilisers and new breeds of plants and animals can, if suitably adapted, produce those social, political and economic inventions which we so desperately need

While the industrial executive in Great Britain and elsewhere has come to recognise that provision must continually be made for new patterns and new techniques, there is no corresponding awareness or equipment for checking and improving the performance of, say, the machinery of government, the health services or the handling of traffic. Immense problems such as the modern scourge of noise, of smoke and chemical pollution in air and water, of street accidents, of crime, of destruction of amenities and many others are allowed to grow up unchecked and almost unobserved The problem is how to make effective the many demands for new knowledge which are at present frustrated because they do not promise profit to particular individuals or undertakings although they may involve great savings to the community Obviously one solution would be a great expansion of State-aided research, but much more thought and inquiry would be needed before concluding that this is the only, or the best, solution

A New Arctic Island

The discovery of a new island in the arctic is now a rare event, but in the *Geographical Review* of January, Mr V Stefansson describes what is probably such an occurrence. In September 1931 a party of Eskimo, searching for whales north of Alaska, came to an island on which they went ashore in a position of approximately lat 71° 20′ N, long 145° 30′ W This is about 85 miles north of Flaxman Island and due east of Point Barrow. The island was reported to be about half a mile long and of the same width and to rise to an altitude of about fifty feet. There was some vegetation but no driftwood Mr Stefansson vouches for the reliability of the Eskimo Takpuk who led the party and whose name has been given to the island Further, he discounts the suggestion that the island was merely earth on floating ice That part of the Beaufort Sea has been little explored though the nearest soundings, some twenty-five miles to the west, show deep water The question arises as to the possibility of Takpuk Island being Keenan Land, reported in the 'seventies of last century and placed in various longitudes in about lat 73° N, but this seems more than doubtful Photographs of Takpuk Island are reproduced with the article

The *Australian Geographer*

The format has been remodelled and the scope changed of the *Australian Geographer*, the periodical published by the Geographical Society of New South Wales It is hoped now to publish it more often than once a year and to give special consideration to the work of Australian writers on the geography of the continent A special feature will be the continuance in every issue of a bibliography of Australian geographical literature. This feature, which begins with the year 1926 in the current issue (No 1, vol 2), should prove of considerable value Another valuable article is that by Dr. M Holmes in the Australian geographical environment, which treats the subject in much detail

Philosophy and Everyday Life

The organ of the Philosophical Society of England, the *Philosopher*, enters on its twelfth year of publication under new editorship and in a new and attractive format As is pointed out in the opening article, the special branches of science have found exponents capable of interpreting their many recent advances to the general reader, and it is the purpose of the *Philosopher* in a similar way to interpret current thought in philosophy and to indicate its contacts with the world of to-day Thus in the issue before us there is an article on "Reason in Action" by Prof John Macmurray, another on "Reflection and Common Sense" by Prof A E Heath and another by Paul Painlevé, the distinguished French mathematician, philosopher and statesman who died towards the end of last year, on "Civilisation and Modern Science" Students of philosophy will perhaps turn more readily to the "Courses of Study", where notes are given on various aspects of the subject, with suggestions for further reading There are also reviews and notices of recent books, a section on educational intelligence, a record of meetings of the Philosophical Society and so on. The journal has thus a double appeal, to the layman and to the student, and at the modest price of 6*d*. should have a wide circle of readers. Copies of the *Philosopher* can be obtained from the Honorary Secretary of the Philosophical Society, 13 Woodlands Road, London, S.W 13

Physica

The first number of the new Dutch periodical *Physica* (December 1933, pp. 96, published by Martinus Nijhoff, The Hague, 25 guilders yearly) contains a number of interesting papers. The paper by de Haas and his co-workers on the attainment of very low temperatures by adiabatic magnetic changes is referred to in our Research Items (p 181) Druyvesteyn describes experiments on the low-voltage arc in sodium vapour. The absorption of the *D* lines was measured in the arc and the reversal of the *D* lines against a continuous source at variable temperature was observed. The results show that the number of excited sodium atoms is about 12 per cent of the number of the normal atoms, and that the number of Na$^+$ ions is several times the [illegible]or of normal atoms The theory of light emission na[illegible]seous discharges is discussed by W De Groot [illegible] Hoel describes a quartz-fluorite combination lens [illegible]uch is achromatic and spherically connected. It intended for focusing light on a thermocouple with unit magnification P Cohen Henriquez describes a micro apparatus for determining the dipole moment of organic solutes The apparatus may be used with a few milligrams of material. The ratio of the lithium isotopes has been determined by intensity measurements of the fine structure of the Li resonance line by Ornstein, Vreeswijk and Wolfsohn. Van Kreveld describes an empirical summation law for a photographic plate exposed to light of two or more colours, and Van der Pol and Weyers describe the approximations known as Tchebycheff polynomials. The papers are in English or German, and in some cases German papers are provided with an abstract in English.

Recent Acquisitions at the British Museum (Natural History)

AMONG the recent acquisitions at the Natural History Museum the Department of Zoology has received as a donation from Mrs. Charles Buckley and Mr. Godfrey R Buckley the mounted head of a cow of the Chartley breed of cattle. Chartley Park was formed by enclosing about 1,000 acres of the forest of Needwood in the reign of Henry III, when a number of half-wild cattle, which then roamed throughout the district, were driven in and enclosed in the Park. Two important additions have recently been made to the beetle collections in the Department of Entomology, namely the Donisthorpe collection of British Coleoptera and an Australian collection purchased from Mr W du Boulay. The former contains upwards of 22,000 specimens, and is of especial interest in that it is accompanied by the most complete set in existence of the numerous British insects (mainly beetles) and other arthropods that live in association with ants and are known as myrmecophiles The du Boulay collection, which numbers only 352 specimens, consists, however, entirely of beetles actually found inhabiting ants' nests in various parts of Australia by Mr. du Boulay over a period of sixteen years Mr R E Turner, working in South Africa, has collected and presented to the Museum some 8,000 insects of various kinds, principally small bees and wasps ; and from the mountains of New Guinea Miss L. E. Cheesman has collected for the Museum upwards of 18,000 specimens. Miss M Graves, M P , has presented to the Geological Department some portions of the egg-shell of a small horned dinosaur, *Protoceratops andrewsi*. The South Australian School of Mines and Industries has presented an end-slice of a large mass (2,520 lb) of meteoric iron found in 1909 at Murnpeowie, South Australia, previously represented in the collection only by a cast of the whole mass

Sunday Lectures at the British Museum (Natural History)

FOR the benefit of visitors to the Natural History Museum on Sunday afternoons who may wish for fuller information about the various branches of natural history than may be obtained by casual wandering through the galleries, the Trustees of the British Museum have arranged for two lectures each afternoon at 3 and 4 30, to be given usually by a member of the scientific staff Lectures illustrated by lantern slides will be given in the Board Room, and the remainder in one of the galleries The opening lecture will be on Sunday, February 4, the lecturer being Capt Guy Dollman, who will speak on the great game animals of Africa and will show a number of lantern slides On succeeding Sundays lectures will be given by Dr W E Swinton on earthquakes, Mr Maurice Burton on seashore animals (both in the Board Room), and Mr J R Norman on the Fish Gallery Admission to the lectures is free

THE Department of Botany of the Natural History Museum has received a bequest of the herbarium of the late Ashley H Maude. The specimens are well mounted on about 5,000 sheets and are in good condition, contained in four cabinets They are chiefly European but there are also collections from Algeria, Cape Colony and the Canary Islands The Godman Trustees have presented 534 specimens of flowering plants collected by Mr F. Ludlow and Capt G Sherriff in Bhutan The area traversed is one which is not very well known botanically and as each 'number' comprises a good series of well-dried plants the collection is of great value A number of seeds were also collected, and these have been distributed This year's collecting season in Nepal was ruined by the monsoon and consequently only fourteen specimens were collected by Prof K. Sharma Those were presented to His Majesty the King and placed by him on loan in the Department of Botany Although the number is small it includes several very important horticultural plants

Empire Museums and the Carnegie Corporation

IT is gratifying to learn (from the December number of the *Museums Journal*) that the Carnegie Corporation has decided to grant substantial sums for the development of the museums of the Empire, following upon the Empire Survey of Museums, to which reference has been made in these notes. Already grants totalling 50,000 dollars have been made in Canada, and it has just been made known that similar sums have been set aside for South Africa, Australia and New Zealand These will be administered by local committees. In addition to the 200,000 dollars thus earmarked, the Carnegie Corporation has also decided to appropriate 63,000 dollars to the Museums Association for a programme of museum development in Newfoundland, Southern Rhodesia and the Colonies.

A Direct Reading Universal Drawing Compass

MR. THOROLD, 20, Rathbone Place, W 1, sends us particulars of a new instrument which is a combination of scale and compass The compass points travel on a beam carrying interchangeable scales. The two points terminate in movable heads on the beam which are adjustable, one possessing a micrometer The instrument is also supplied with calliper points for external and internal measurements The maker claims that great accuracy is obtainable, and for fine drawing in the field of physical science and engineering the invention seems likely to be valuable The cost of the instrument is £7 7*s*

Austrian Ethnographical Expedition to West Africa

AN expedition, of which Dr Ralph Elber, of the Institute of Egyptology and African Studies, is the leader, left Vienna, according to a communication issued by the Reichszentrale fur Wissenschaftliche Berichterstattung, Berlin, early in January for Sierra Leone, whence it will proceed to Liberia for the purpose of exploring the interior of the country and observing the little-known tribes of that region Special attention will be given to the study of the religious and magical beliefs of the tribes and their languages, which are virtually unknown The results of this expedition should be of special interest in view of present lack of knowledge of the area, its inhabitants and natural history It is also hoped to add to the map particulars of one of the last uncharted areas of Africa

Pittsburgh Award of the American Chemical Society

THE Pittsburgh Section of the American Chemical Society has selected Dr Ralph E. Hall, director of the Hall Laboratories, Inc , Pittsburgh, Pa , as the recipient of the 1933 (the first) Pittsburgh Award This honour, which will be conferred on Dr. Hall at the sectional meeting on February 15, is in recognition of his distinguished service to chemistry and humanity, particularly his contributions to the fundamental knowledge of boiler-water reactions and their applications to the practical solution of boiler-water problems, his discoveries and technical accomplishments in the beneficiation and conditioning of water for industrial and domestic use, and his developments in the production of chemicals for these purposes The Pittsburgh Award is represented by a plaque of gold, on which the relation of chemistry to industry is symbolised

Announcements

SIR WILLIAM LARKE, K.B E , Director of the National Federation of Iron and Steel Manufacturers ; Prof. Edward Mellanby, F.R S , Secretary of the Medical Research Council ; and Mr Leonard Woolley, Director of the Joint Expedition of the British Museum and of the Museum of the University of Pennsylvania to Mesopotamia, have been elected members of the Athenæum under the provisions of Rule II of the club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts or for public service.

SIR ARTHUR EDDINGTON will deliver the Rickman Godlee lecture at University College, Gower Street, London, W C 1, on Friday, February 16, at 5 30 p.m. The subject of Sir Arthur's lecture will be "The Constitution of the Stars". The lecture will be open to the public.

PROF A ZIMMERN, Montague Burton Professor of International Relations in the University of Oxford, is giving a course of six lectures (Muirhead Lect· in Social Philosophy) at the University of Birm ham on Thursdays, beginning on February 1, "Britain and the World Crisis".

MISS NINA SYMINGTON, daughter of the late Pr . Symington of Belfast, has bequeathed the residue of her estate, amounting to some £9,000, to be known as the Johnson Symington Memorial bequest, to the Anatomical Society of Great Britain and Ireland for anatomical research

THE Council of the Institution of Naval Architects has awarded the Gold Medal for the year 1933 to Eng.-Capt. S. R Dight, for his paper on "Naval Water-Tube Boilers Experiments and Shop Trials" ; and the premium to Dr. George Hughes, of the William Froude Laboratory, for his paper on "The Effect of Wind on Ship Performance".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A chemical assistant to the advisory chemist in the Department of Agriculture, University of Cambridge —The Secretary, School of Agriculture, Cambridge (Feb 10). A junior assistant (chemist) in the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk, Central Office, Royal Gunpowder and Small Arms Factories, Enfield Lock, Middlesex (Feb 10). A head of the Department of Civil Engineering and Building, and a head of the Science Department in the Lester School and Institute, Shanghai—Messrs. Viney, Price and Goodyear, Empire House, St. Martin's-le-Grand, London, E C.1 (Feb. 20). A director of the University School of Librarianship at University College, London—The Academic Registrar, University of London, S.W.7 (March 1). A University lecturer in moral science in the University of Cambridge—The Secretary of the Faculty Board of Moral Science, King's College, Cambridge (March 1). A University lecturer in forestry in the Department of Agriculture of the University of Cambridge—The Secretary, School of Agriculture, Cambridge (April 14). A keeper of the Museum at the Victoria University of Manchester—The Registrar (April 30). A research assistant (male) in the Cancer Research Department of the Westminster Hospital, Broad Sanctuary, London, S.W.1—The Secretary. A registration officer and statistician, and a finance officer and accountant for the Potato Marketing Board—The Secretary, Potato Marketing Board, 45 Bedford Square, London, W.C.1.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Designation of Heavy Hydrogen

IN a recent issue of NATURE (132, 955; 1933) Lord Rutherford has suggested that the heavy ‘ope of hydrogen be named diplogen, instead of name deuterium proposed by us This was one me considered by us before we published our uggestion of the names protium and deuterium for the two isotopes of hydrogen.

Our objection to this name arises from the difficulty of naming compounds which contain two of the heavy hydrogen atoms. Thus the compound $NH^1H^2_2$ would be called di-diplogen mono-hydrogen nitride The part of this name which we think is unfortunate is the repetition of the syllable ‘di’ in the name, and it was for this reason that we discarded this name for the heavy isotope Also, we believe that the two isotopes of hydrogen should be treated symmetrically, and the corresponding name, haplogen, for the hydrogen of mass 1, did not appeal to us. Moreover, both names have a rather forced meaning ‘To generate double’ and ‘to generate single’ seem to have no evident applicability to the hydrogen isotopes such as the corresponding meaning of the word hydrogen has

The objection to the name deuterium for the substance H^2 and the name deuton for its nucleus, seems to be founded upon the possibility of confusing the word neutron and the name deuton Perhaps the use of the name deuteron would eliminate this difficulty. It is interesting indeed that American scientific workers do not have any such difficulty so far as we are aware.

It may be of interest to readers of NATURE in connexion with the discussion of names for this substance if we list some of the names considered by us before we proposed these names These include :

Haplogen for H^1 and diplogen for H^2. These names were discarded for the reasons given above

Hydrogen for H^1 and bar-hydrogen for H^2, with the symbol $\bar{H}$ for the latter This we discarded because it is a four-syllable word and because people generally seemed to dislike the sound of it Thus di-bar-hydrogen would occur in some chemical compounds and the two prefixes seem very awkward.

Barogen for H^2 and pycnogen for H^2. Both these names were eliminated because they did not sound euphonious and also because we feared that it was emphasising the increased density of the compounds too much.

Iso-hydrogen for H^2. This was eliminated because the term iso is a common term for naming organic compounds.

Dygen for H^2. We eliminated this name because of the impossibility of making any of the usual chemical combining terms.

We finally agreed upon the names protium and deuterium because they place the two isotopes of hydrogen as equal, both being hydrogen, and because of their meaning as first and second, and because we felt they were the most descriptive of these names. We were influenced in the selection of deuterium by the preference of others for the name deuton, though we preferred to use the entire Greek stem rather than to abbreviate it

As Lord Rutherford states, the question of naming this isotope is so important that a general discussion of the name is very desirable at this time. We are not only giving a name to a single isotope, but we are perhaps also introducing a system for naming other isotopes in the future Whatever names are finally selected, we do believe that both isotopes of hydrogen should be named and the name hydrogen be used to apply to both of them, and that this principle be adhered to in the future in naming any other isotopes This question of course is not important at the present time, but we think that it would be too pessimistic to believe that other isotopes will not be separated in quantity in the future

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CHEMISTS cannot admit such fearsome wild fowl as *Diplogen* to their sanctuary of elements -elements no longer, subject as they are to protono-decapitation and reheading to satisfy simple sums Diplogen is an offence against the usages of the house chemical, philologically unsound and bereft of reason The *gens* are all gentles with specific functions . hydrogen the *gen* of water ; oxygen the *gen* of acid , nitrogen the *gen* of nitre Diplogen, the gen of twins, can have no place in such company Diplog*en*, if you will, as it has so gone to the heads of physicists—but Diplog*en*, never ! It's a twin not a twinner Fish will leave the waters, if they learn that such a monster is around

Why not simply *Deuthydrogen*, as it is the second term in the hydrogen series ? Should a Triton appear among these minnows, it will be Trithydrogen We shall then be naming it in accordance with the principle adopted in homologous hydrocarbon series. After all, the American parents alone have the right to decide what the child's name shall be—whatever Dr Aston may assert Still, he is scarcely to be ranked as an authority—as he will not recognise distinction between ‘composition’ and ‘constitution’. Much measuring has made him oblivious of meanings

We notice elsewhere a suggestion of the name *Woollywestium*, Ww. Such a name would invite its wearing next the skin, whilst taking cognisance of a Californian birthplace.

We cannot allow physicists to muddle our language : as they have done in their varied misuse of Faraday's incomparable term ion , in their continued failure to distinguish between atom and molecule—to give only two examples Their run of the significance of ion is a disaster, an insult to Faraday's memory , our literature is thrown into entire confusion thereby.

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Activities of Life and the Second Law of Thermodynamics

I AM very glad to have elicited Prof. F. G Donnan's critical views (NATURE, Jan 20, 99) on my suggestion as to life and thermodynamics, but confess I remain unconvinced by his arguments

Prof Donnan challenges my neglect of the body metabolism or fuel oxidation which, as he says, necessarily accompanies the arrangement or disarrangement of material objects by human activities, considering that such chemical changes may produce an increase of entropy sufficient to offset any decrease produced by human intelligence No doubt it may, but I cannot see that these two effects are "functionally inter related" or in any way suitable subjects for comparison Given perfectly level and frictionless railways, a man may move millions of tons of matter, and thereby decrease the entropy of the world enormously, without incurring any corresponding increase of entropy through the combustion of food or fuel Any increase of entropy which occurs in practice is a mere side-issue, an accident resulting from the impossibility of realising ideal conditions, and so should not enter into the theoretical discussion at all

A further increase of entropy might of course occur if the mental effort of arranging objects caused an increase in bodily metabolism I believe orthodox physiology teaches that any such effect is inappreciable, but it is in any case obvious that it cannot be relied on to offset the decrease of entropy resulting from intelligent arrangement We cannot, for example, suppose that the man who steers the *Mauretania* consumes food-energy at a rate comparable with 100,000 h p more than normal, merely because he is guiding a ship of that horsepower

Prof Donnan's parallel from crystal growth seems to me to fail through identifying "increase of organisation" with "decrease of entropy". The two are equivalent so long as potential energy is unimportant, but when this becomes preponderating, as in a crystal, maximum entropy may well demand regular packing, and so *maximum*, not minimum, organisation.

J. H JEANS

Crystal Structure of Lanthanum, Cerium and Praseodymium Hydrides

THE original metals were La α (hexagonal close packed arrangement, $a_0 = 3\ 75_7$ A, $c/a = 1\ 61$), Ce β (face centred cubic, $a_0 = 5\ 14_6$ A, Pr α (hexagonal close packed, $a_0 = 3\ 65_2$, $c/a = 1\ 61$)

Lanthanum annealed in vacuum at 350° C, for several days, furnished powder photographs similar to those described very accurately by Zintl and Neumayr[1] for the β phase (face centred cubic) of this element I have noticed that by removing a very thin outer layer from the annealed specimens, the latter gave again the characteristic photographs of the α modification, that is, it was merely a surface phenomenon

Praseodymium subjected to the same thermal treatment did not modify its structure The specimens annealed in vacuum at 750° C for 48 hours furnish photographs of a somewhat different aspect, but yet not corresponding to a possible allotropical β form

The difficulty of hydrogen absorption increased in the order cerium, lanthanum, praseodymium In any event, the thermal treatment which was necessary to start the hydrogen absorption, repeated in vacuum on some specimens of the last two elements (α modification), did not change their crystal structure

The hydrides of the above mentioned metals all showed face-centred cubic lattices, with sizes larger than those pertaining to the real or possible β phases of the original pure elements

Lanthanum hydride furnished in one case photographs revealing the simultaneous presence of two face-centred cubic phases, having for side $a'_0 = 5\ 62$ A., $a''_0 = 5\ 70$ A. (hydrogen absorbed, about 140 c mm per gm) Generally, however, only one face-centred cubic phase appeared, having a of $a_0 = 5\ 62\ 5\ 63$ A (hydrogen absorbed, ab 200 c mm per gm) If the hydrogen was remov by heating and a vacuum pump (at 1 mm pressure) the size of the lattice seemed to increase a little (at 530° $a_0 = 5\ 65$ A, at 700° slightly greater values)

Cerium hydride showed a lattice with side $a_0 = 5\ 61_3$ A which by removal of the hydrogen in vacuum at 530° split up into two similar phases of slightly smaller dimensions

The lattice of praseodymium hydride (absorbed hydrogen, about 165 c mm) was only slightly larger (some hundredths of an angström) than that of metallic cerium, that is, than that which a hypothetical β phase of praseodymium would give, according to the small existing difference between the atomic diameters of praseodymium and cerium in the α phase

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R Università di Firenze

[1] *Z Elekt ang phys Chem*, 39, Nr 2, 84, 1933

Magnetic Anisotropy of Graphite

GRAPHITE is known from the investigations of Owen, Honda and others to exhibit an exceptionally large magnetic anisotropy. The susceptibilities of the natural crystal along its hexagonal axis and along perpendicular directions are, according to Honda[1]·

$$\chi_1 = -14\ 2 \times 10^{-6}\ ;\quad \chi_2 = -2{\cdot}2 \times 10^{-6}$$

respectively, per gm., χ_1 being thus more than six times χ_2 Recently Goetz and his collaborators have found a much higher value for the ratio χ_1/χ_2 Chemically treated pure graphite powder is dispersed by them in a solution of gum Dammar in benzene, the solution is placed in a strong magnetic field and the benzene is allowed to evaporate. All the graphite particles in the solidified medium will then naturally be oriented in the same manner, namely, with their hexagonal axes normal to the direction of the imposed field From susceptibility measurements on this medium they found[2] for χ_1/χ_2 a value of 13 2 Later[3], using graphite particles dispersed in this manner in a solidified solution of agar, they obtained a still higher value, namely, 18 Their more recent estimate[4], obtained from a similar suspension of graphite particles in gelatine, is so high as 28. It would thus seem desirable to determine the anisotropy of graphite by an independent method.

The following measurements made with some good specimens of Ceylon graphite, by Messrs B. C. Guha and B. P Roy in this laboratory, may therefore be of interest The method adopted in these measurements was the same as was described in previous papers[5]. By suspending the crystal, with its hexagonal axis horizontal, at the end of a calibrated quartz fibre, in a uniform magnetic field, and measuring the couple due to the magnetic anisotropy of the crystal, the *difference* between the two principal susceptibilities, namely, $\chi_1 - \chi_2$, was determined. With the same suspension, the absolute value of χ_2 was measured by magnetically balancing the crystal in a field of large non-homogeneity, against an aqueous solution of potassium iodide, the susceptibility of which could be adjusted by suitable dilution.

Altogether ten different crystals were measured for $\chi_1 - \chi_2$, and the values obtained ranged from $-21 8 \times 10^{-6}$ to $-23 0 \times 10^{-6}$ per gm. The values for χ_2 varied about a mean value of $-0 4 \times 10^{-6}$ Hence the principal susceptibilities of these crystals per gm are:

$$\chi_2 = -22 8 \times 10^{-6}, \chi_1 = -0 4 \times 10^{-6}$$

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Nov 23

K S KRISHNAN

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[1] "Int Crit Tables", 6, 364
[2] *Phys Rev*, 39, 108, 1932
[3] *ibid*, 39, 553, 1932
[4] *ibid*, 40, 1053, 1932
[5] *Phil Trans*, A, 231, 235 232, 99 1933

Rate of Ionisation of the Atmosphere

THE rate of atmospheric ionisation (q), as calculated from observations of small ions and nuclei, has been found to attain a maximum at approximately 18 hours G M T in such widely separated localities as Glencree[1], Washington[2] and Canberra[3]

Recently a series of direct observations of q has been completed at the Commonwealth Solar Observatory A large 'unshielded' ionisation vessel was refilled with the outer air at hourly intervals and the saturation currents measured The hourly means of observations extending over forty complete days were

G M T	q	G M T	q	G M T	q	G M T	q
0	25 6	6	21 5	12	29 0	18	37 8
1	23 6	7	23 8	13	32 0	19	35 4
2	21 3	8	24 1	14	32 0	20	35 1
3	21 5	9	26 0	15	33 4	21	31 9
4	21 4	10	27 6	16	35 9	22	32 0
5	21 4	11	28 4	17	38 0	23	29 2

The columns headed G M T show the hour at which the filling of the vessel was completed; those headed q give the rate of ionisation of the air in the vessel in ion pairs per cubic centimetre per second

A ten-day series of observations, made upon a sample of air which had been confined in the vessel for four weeks, showed the background ionisation to be 15 6 ion pairs per c c per second, and to be constant to within ± 1 per cent throughout the day

Although the above figures may be subject to certain small corrections, they show that the rate of ionisation of the lower atmosphere undergoes considerable diurnal variation

Whether the approximate agreement of the maximum at Glencree, Washington and Canberra is more than a chance coincidence can be determined only by observations in other localities.

Commonwealth Solar Observatory,
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Dec. 1

A. R. HOGG.

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[1] J J Nolan and P J Nolan, *Proc Roy Irish Acad.*, 40, 11, 1931
[2] G R Wait and O W Torreson, NATURE, 129, 401, March 12, 1932.
[3] A R Hogg, *Gerl. Beitr. Geophys* (in press)

Ionospheric Measurements in the Polar Regions

THIS note is a brief account of the results of wireless observations made in connexion with the International Polar Year 1932–33 at Murmansk (lat 68° 56′ N, long 33° 05′ E) in the U S S R during June, July and August 1933 This work was organised by the Leningrad Section of the Institute for Scientific Research of the People's Commissariat for Communication in association with the Central Geophysical Observatory and was carried out under my direction

A special system with two 150-watt tubes was designed in order to send out short pulses of 20 kw energy This was accomplished by using a condenser charged to high tension by a rectifier. By means of a rotary spark gap, this condenser was discharged fifty times per second through the plate circuit of the tube oscillator, in which short oscillations of great power were thus produced The rest of the time the condenser was not connected to the oscillator and the charge was gradually stored up. Thanks to this method, it has been possible to carry out experiments under the conditions of an expedition, using but a small power

The observations were made with a cathode ray tube, the circular motion of the spot was caused by the current of a small alternator, driven on the same shaft as the transmitter discharger The transmitter and the receiver were separated by a distance of three kilometres and connected by wire

Several unusual phenomena were found which must have been due to specific conditions of the ionosphere in polar regions Shortly, the results obtained may be summarised as follows

In the polar regions during the summer solstice and for some time after, both the main reflecting layers *E* and *F* of the ionosphere are found to exist. The *E* layer is in general less active than in temperate latitudes and therefore but seldom capable of screening the *F* layer It is mostly in evidence for waves of 75 m and 110 m around midnight and occasionally by day

The daily variations of ionisation are in some cases similar to those in temperate latitudes, whereas sometimes they were of an opposite character. Pictures for noon and midnight were nearly always alike, but differed from those for intermediate hours.

Very complex reflections from the upper region are due to the stratified or undulatory structure of the ionosphere Rapid motion is found to exist in this layer

No increase of the shielding effect of the *E* layer and no changes in absorption have been observed at times when this layer dropped to a height of 65 km This seems to indicate that in this case such a low level of the *E* layer is due to changes in the distribution of gas pressure at great heights and corresponds to a deep barometric minimum of the upper atmosphere.

Periods of complete cessation of echoes have been observed, which lasted sometimes for several hours; sometimes, however, the echoes were absent only for one minute or even less The picture of reflections before and after such a short absence of echoes was found to be the same

Such observations suggest that this disappearance of echoes is due to some factor, having the character of a screen, placed between the observer and reflecting layer at an intermediate height, or, it may be said, that a separate 'absorbing layer' is produced at times below the *E* layer, at a height probably less than 65 km.

The character of these phenomena offers some basis for explanation of the structure of this layer: it may be composed of separate moving masses, shielding the Kennelly Heaviside layer (as does a cloud, when it covers the sun) or produced by some variable agent, and is able to appear and disappear very rapidly Further light might be thrown on this question by comparing moments of echo cessations at two points not very far apart

No correlation was found between the changes taking place in the *E* and *F* layers and the presence or absence of the absorbing layer Therefore the absorbing layer must be considered as an independent formation quite apart from the *E* layer and due to other agencies than the *E* and *F* layers

There is undoubtedly direct correlation between the phenomenon of echo cessation and magnetic activity.

The difficulty caused by magnetic storms of maintaining continuous wireless communication over high latitudes may be attributed to the existence of the absorbing layer

These results agree in general with those obtained by Prof E V Appleton during his observations at Tromsø (NATURE, Sept 2, p 340)

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Nov 14

Basking Shark in the Bab el Mandeb

WHEN passing through the Strait of Bab el Mandeb in November 1933 on board the Dutch mail steamer *Johan van Oldebarnevelt*, my attention was directed to the fact that a big fish was fastened on the bow of the vessel So long as the latter continued running at full speed, the shape of the fish could not well be determined. It was evident only that the enormous tail was turned to the right side and could be seen moving now and then as if the fish were still alive, the tip reaching the surface of the water occasionally

After the vessel had diminished its speed and finally stopped, what I had suggested was confirmed, namely, that we were dealing with the big 'whale shark' or 'basking shark' (*Rhineodon typus*) The shape and the very conspicuous colour-pattern (white lines, intersecting each other at right angles, and white blotches on a black ground) could be very clearly distinguished The animal had been 'rammed' by our vessel in a similar way to that already recorded by E W Gudger for the same species in a few cases, just behind the left pectoral fin, so that it could not free itself and remained fastened with the left side of the back to the sharp bow of the ship After the ship had stopped the fish got free, showing a big wound on the left side and sinking down slowly into the depth I could not state with certainty whether it was still alive. I estimate its length at 6–8 metres.

As stated above, similar cases of this kind have been recorded by Gudger, namely, one that happened near Abrolhois Light off the coast of Brazil, and another near the mouth of the Sassandra River in the northern part of the Gulf of Guinea

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New Methods for Direct Visualisation of Ultra-sonic Waves and for the Measurement of Ultra-sonic Velocity

MEASUREMENTS of ultra-sonic velocities in liquids can be easily made by the method of Debye and Sears or Lucas and Biquard[1], who used the periodically alternating densities produced in a liquid by ultra-sonic waves as an optical grating. Such measurements have been made in this department at the suggestion of Prof H. Falkenhagen, who wanted more precise data on the compressibilities of electrolytic solutions. In the pursuit of these researches we have found it preferable to visualise this 'optical grating' directly instead of using it for the diffraction of light. Details of the new method will be given in a forthcoming publication in the *Zeitschrift für Physik*. The picture reproduced as Fig 1 is a photomicrogram of a stationary ultra-sonic wave formed at a convex mirror in xylol, frequency about 4500 kHz It is possible to measure the distance of the nodal lines very precisely. By measuring a great number of nodal lines, we are able to make measurements of ultra-sonic velocities in liquids with the highest precision

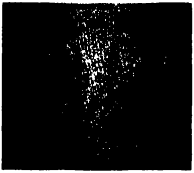

FIG 1 Stationary ultra-sonic wave formed at a convex mirror

In order to clear up some theoretical problems on which such successful pioneer work was done by R. W Boyle[2], it is necessary to use progressive waves instead of stationary ones We succeeded also in the direct visualisation of ultra-sonic progressive waves by using a high-frequency stroboscope based on the principle of the Kerr cell. This enables us to study a sound field without disturbing the field itself We can also measure directly with a microscope or a comparator the distance of subsequent wavefronts of progressive ultra-sonic waves This is another new method for the measurement of ultra-sonic velocity with the highest precision.

The advantages of our new methods will be discussed elsewhere shortly.

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Dec 23.

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[1] P Debye and F W Sears, *Proc Nat Acad Sci*, 18, 410, 1932 R Lucas and P Biquard, *J Phys et le Rad*, 3, 464, 1932

[2] R W Boyle, J F Lehmann and C D Reid, *Trans Roy Soc Canada*, 19, 167, 1925, and many other papers by Boyle and co-workers

The Mechanism of the Kolbe Reaction

IT has been observed by us that a variety of substances which are good catalysts for the decomposition of hydrogen peroxide produce a marked deviation of the anodic processes occurring during the electrolytic oxidation of thiosulphate[1] and of sulphite[2], and in the liberation of halogens[3]. We have now found that in the electrolysis of acetate solutions, relatively small amounts of plumbous, manganous, cupric, ferrous or cobaltous ions have a profound influence on the course of the Kolbe reaction For example, the addition of 0 001 *M*-lead acetate to a solution containing *N*-potassium acetate and *N*-acetic acid reduces the efficiency for ethane formation at a platinum anode from about 70 per cent almost to zero, when using a current density of 0·025 amp. per sq cm.

The effects of the ions mentioned are in the order Pb˙>Mn >Cu >Co = Fe , and an independent consideration of their catalytic influence on the decomposition of hydrogen peroxide, under the conditions prevailing at the anode during the electrolysis of an acetate solution containing acetic acid, has led us to arrange these ions into the groups (Pb , Mn) > (Cu , Co , Fe) This parallelism suggests the possibility that hydrogen peroxide is the effective agent in the formation of ethane by the Kolbe reaction, just as it appears to be in the other anodic oxidation processes we have studied.

A comprehensive investigation of the mechanism of the Kolbe synthesis was commenced some time ago, but as a period is likely to elapse before the final conclusions are ready for publication, we consider it desirable to make a preliminary announcement of the important observations relating to the effect of catalysts for hydrogen peroxide decomposition

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A HICKLING

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Jan 5.

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[1] *J Chem Soc*, 2345, 2800, 1932
[2] *ibid*, 829, 1933
[3] *ibid*, in the press

Possible Chemical Nature of Tobacco Mosaic Virus

IN a recent issue of NATURE[1] Barton-Wright and McBain give results of experiments on the precipitation of virus from infected tobacco juice The method they used was that of Vinson and Petre, which consists essentially of the precipitation of the protein and other materials from the plant juice with basic lead acetate and the subsequent removal of the virus by elution with potassium-hydrogen phosphate solution Barton-Wright found that if the mixed phosphate eluate be acidified to a *p*H of 5 (which means, in effect, the conversion of the alkaline to the acid phosphate, KH_2PO_4) and 2 volumes of acetone added, a precipitate is thrown down, which is partly colloidal and partly crystalline. The colloidal material is largely protein in nature and is rich in virus. The crystals also contain virus.

I have been working on similar lines for the past two years, and I am in agreement with Barton-Wright and McBain up to this point. Barton-Wright and McBain, however, claim that they have been able to purify the crystals by repeated recrystallisation until they contain no nitrogenous material but still contain virus, and that no crystalline material was formed from healthy juice similarly treated. My experience may be of interest in this connexion. I have determined the presence of virus in the crystals quantitatively as well as qualitatively, using the N. glutinosa method In the original crystals there is a small virus content and some protein. As the crystals are washed and reprecipitated, virus appears in the supernatant liquid, and at each recrystallisation the amount of virus in the crystals is reduced After repeated treatment the crystals still contain a little virus, much less than originally, and they still contain a trace of organic nitrogen on microanalysis Nitrogen-free virus-containing crystals have not been obtained. I have found no evidence that the crystals contain virus except as an impurity

That the crystals have no specific relation to the virus is easily demonstrable If the K_2HPO_4 eluate from healthy tobacco tissue be acidified as was that of the infected material and two volumes of acetone added, a crystalline as well as a colloidal precipitate is obtained, despite the statement of Barton-Wright and McBain The amount of this crystalline portion of the precipitate depends on the concentration of the phosphate solution used in the elution of either the healthy or the infected juice If an $M/1$ K_2HPO_4 solution be used, the precipitate of crystals is very large

It can readily be shown that the crystals are due to the presence of KH_2PO_4 by the fact that the addition of two volumes of acetone to one of $M/1$ KH_2PO_4 in aqueous solution results in a heavy white precipitate of rhombic crystals, indistinguishable in outline from those obtained in the experiments recorded above

JOHN CALDWELL

Rothamsted Experimental Station
Jan 23

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[1] NATURE, 132, 1003, Dec 30, 1933

Activity of Crystalline Preparations of Vitamin B_1

IN an important letter, Dr. van Veen[1] describes the isolation of a vitamin B_1 preparation from rice polishings more potent by rice bird tests than our own At the same time he mentions that his activity reaches 500,000 units per gm It is well to realise that some of our most potent specimens have shown this activity by pigeon test[2], so that a final judgment upon the question must await further work

In addition to the strong probability that most vitamin B_1 crystals contain inactive vitamin, we must reckon with the further complication of different analytical figures. Dr van Veen's new crystals have the same analytical figures as previously, whereas repeated work shows that analysis of our crystals differs significantly and constantly from his (and others) in several respects, for example, C 42 2 per cent instead of 40 7 per cent Hence active torulin (from baker's yeast) appears to be different from active oryzanin. At present these differences cannot be reconciled with the published results of X-ray analysis[3].

We acknowledge with gratitude a specimen of Dr. van Veen's B_1, which is now under test.

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J. R O'BRIEN.
R. A PETERS

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Jan. 27.

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[1] NATURE, 133, 137, Jan 27, 1934
[2] *Biochem. J*, 27, 232, 1933
[3] NATURE, 131, 911, June 24, 1933

Refractive Indices of *l*-Ascorbic Acid

E. G. Cox[1] states that *l*-ascorbic acid is optically negative with $\alpha = 1·462$, $\beta = 1·68$, and $\gamma > 1·70$. We have examined a material isolated from peppers after the method of A. Szent-Gyorgyi[2] by Dr. A. G. Grollmann, of the Johns Hopkins Medical School. This substance gives the characteristic absorption spectrum of *l*-ascorbic acid with a maximum coefficient[3] at 2650 A., the melting point is 188°, and the analysis (Mrs. M. S. Sherman) C, 40·80 per cent, H, 4·78 per cent (calculated for $C_6H_8O_6$, C, 40·89 per cent, H, 4·58 per cent). The compound as crystallised from methyl alcohol or acetone has $\alpha = 1·465$, $\beta = 1·600 \pm 0·006$, and $\gamma = 1·747$ for λ 5780 A. The optical sign is either positive or negative within the limit of experimental error, as is verified by the lack of curvature of the isogyre in a centred optic axis interference figure. No evidence was found for structural polymorphism, but the possibility was not rigorously eliminated. These constants, which are for crystals of the type shown in Szent Györgyi's Fig. 2a[2], are published since they are of value in identification of ascorbic acid and since they substantiate Cox's deduction of a plane configuration for the molecule, which is in accord with the accepted furanose ring structure.

STERLING B. HENDRICKS

Bureau of Chemistry and Soils,
Washington, D.C.
Dec. 10.

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[1] NATURE, 130, 205, Aug. 6, 1932.
[2] *Biochem. J.*, 22, 1387 ; 1928.
[3] Note R. W. Herbert, E. L. Hirst, E. G. V. Percival, R. J. W. Reynolds and F. Smith, *J. Chem. Soc.*, 1270 ; 1933.

Uroflavin, Maltoflavin and Redox-Potentials of Lyochromes

BESIDES hepatoflavin, the isolation of which was described in these columns recently[1], two further members of the lyochrome series have been obtained in a highly purified, though not definitely pure and crystalline state: uroflavin from normal human urine* and maltoflavin from malted barley. The process of preparation is very similar to the procedure adopted for the isolation of hepatoflavin.

Uroflavin as well as maltoflavin exhibit much the same properties as the lyochromes previously described. The yellow-red solutions show a strong green fluorescence. Whereas earlier observations with nickel oxide glass filters suggested that the fluorescence of lyochromes is mainly due to ultra-violet light, it was found by the use of a quartz monochromator that visible light of the blue-violet region and not ultra-violet radiation is responsible for the fluorescence. Both lyochromes yield chloroform soluble 'lumi-flavins' on strong irradiation in alkaline solution. Finally, both pigments lose their colour and fluorescence on reduction and regain these characteristics after reoxidation. The spectrographic examination, for which I am much indebted to Dr. E. R. Holiday, showed that maltoflavin and also uroflavin possess a sharp absorption band in the ultra-violet, the peaks of the band being at 255 mμ and at 281mμ respectively. In contrast to other lyochromes, there seems to be no specific absorption in the range of longer wave-lengths. The absorption curve of hepatoflavin shows two maxima, a sharp one at 258mμ and a flat one around 360mμ.

The potentiometric study of the three lyochromes proves that they represent perfectly stable oxidation-reduction systems. Even in low concentration they impart stable and fairly reproducible potentials to noble metal electrodes within the range of a reasonable redox buffering capacity. As reductants hydrosulphite or palladium-hydrogen, and as oxidants ferricyanide or molecular oxygen, were used. The position of the normal potentials (E'_0, referring to the normal hydrogen electrode) was found as follows: Hepatoflavin: *p*H 5·88, $E'_0 = -0·177$ v.; *p*H 7·3, $E'_0 = -0·219$ v.; *p*H 8·62, $E'_0 = -0·274$ v. Maltoflavin: *p*H 7·4, $E'_0 = -0·216$ v. Uroflavin: *p*H 7·2, $E'_0 = -0·217$ v. (phosphate buffer of isotonic strength was used throughout). The titration experiments were performed at room temperature (16°–19·5° on different days, constant within 1° during the experiments). The curves obtained so far indicate an electron number of $n = 1$ rather than of $n = 2$. It should be mentioned that Bierich *et al.*[3], working with a product from mammalian tissues which is probably identical with lumi-flavin[1], report an E'_0 of $-0·217$ v. at *p*H 7·2 and of $-0·139$ v. at *p*H 5·39, but give index potentials corresponding to $n = 2$.

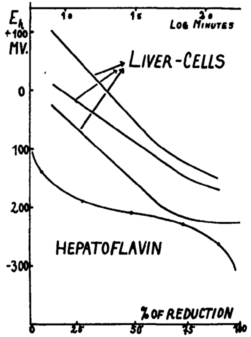

FIG. 1.

The physiological significance of the extremely negative position of the normal potentials of these widely distributed biological redox-systems awaits elucidation. Under normal aerobic conditions, if there is such a state as a uniform aerobic reduction potential (which would then be near to $r_H = 12$)[4], the cell flavin would be present entirely in the oxidised state. But around $r_H = 7$ ($E_h = -200$ mv.), which is considered to be the general anaerobic reduction potential of living cells, the cell flavin is exactly in its equilibrium range. This fact is illustrated in Fig. 1, which in its upper part shows an experiment of Clark *et al.*[5], in which the reduction potential of liver suspensions in phosphate buffer at *p*H 7·4 was observed, whilst in the lower part one of our curves obtained on reduction of hepatoflavin at pH 7 3 is given.

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* Uroflavin is a component of the urochrome fraction, but not identical with urochrome *A* or *B* (cf. [2]).

Another striking coincidence is represented by the fact that the normal potential of the lactate-pyruvate-enzyme system[6] is almost identical with the normal potential of the flavins at the same pH (E'_0 being respectively -200 mv and -219 mv (hepatoflavin) at pH 7) The relation between the flavin potential and the equilibrium conditions in enzyme-substrate systems is under investigation

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[1] K G Stern, NATURE, 132, 784, Nov 18, 1933

[2] K G Stern and G D Greville, *Naturwiss*, 21, 720, 1933

[3] R Bierich, A Lang and A Rosenbohm, *ibid*, 21, 496, 1933

[4] R Chambers, L V Beck and D E Green, *J Exp Biol*, 10, 142, 1933

[5] R K Cannan, B Cohen and W M Clark, Suppl 55, Publ Health Rep Washington, 1926

[6] R Wurmser and N Mayer-Reich, *J Chim Phys*, 30, 249, 1933 J P Baumberger, J J Jürgensen and K Bardwell, *J Gen Physiol*, 16, 961, 1933 I Banga, K Laki and A Szent-Györgyi, *Z physiol Chem*, 217, 43, 1933

A Camera Method for Charting Quadrats

THE botanical analysis of pastures by means of quadrats should combine both speed and accuracy Up to the present, the rapid methods have been somewhat subjective, and in many cases the results obtained cannot be compared closely owing to variation in the personal factor The more intensive objective analyses, on the other hand, have sacrificed speed to greater accuracy The following method of quadrat charting has accordingly been devised in order to secure both speed and accuracy, and is of special value in the charting of open tufted swards such as those commonly found in South Africa

The apparatus consists of a wooden square metre quadrat to which is screwed a tressel with an extra leg at each end to secure rigidity. The precise form of this tressel is unimportant, that it should be rigid is all-important The tressel supports a camera directly over and focused towards the centre of the quadrat The image of the quadrat is thrown not on to the usual frosted focusing glass, but on to a *sheet of plain glass* upon which is secured a *sheet of transparent (or oiled) squared paper* The image of the vegetation within the quadrat can then be traced by pencil with ease and accuracy upon the paper

In using the apparatus, it is desirable to have two workers, one tracing the outline of the plants (basal cover or otherwise), the other moving the foliage of the grass, etc, to render the outlines clear to the tracer, and, if necessary, identifying the species For ease in working, the light-hood screening the image should fit closely to the top of the camera, and be provided with eye-pieces and an arm-hole at the side Both vertical and lateral adjustments of the camera are provided for on the frame, but once the correct position is obtained no further adustments are necessary

The method has several advantages

(1) The apparatus is readily constructed from simple material Any half-plate camera can be employed, provided it has a suitable wide-angle short focus lens (approximately 5 4).

(2) The apparatus is collapsible and can be fastened into a small bundle for moving long distances; for short distances, the whole apparatus when set up can be moved with ease.

(3) Once adjusted, no further adjustments are necessary

(4) Photographs of the charted vegetation may be obtained if necessary by merely substituting the dark slide for the glass plate.

(5) It is both rapid and accurate in use A tufted sward, composed of a number of different species, can be charted and identified in ten to fifteen minutes

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Diethyl Peroxide as a Pro-Knock

IN spite of the considerable literature, there seems to be no special reference[1] to the properties of diethyl peroxide as a pro-knock In view of its possible importance in some theories of hydrocarbon combustion, it was of interest to investigate its behaviour in the engine Diethyl peroxide is a violent pro-knock, slightly more potent than amyl nitrite at the same concentration Its knocking action is inhibited by lead ethyl

Ethyl hydrogen peroxide is likewise definitely a pro-knock In spite of the ease of thermal decomposition, 30 per cent of hydrogen peroxide was found to have definite, but very slight, pro knock tendency

Apart from the possible theoretical significance of these facts, which is being discussed elsewhere, it seems desirable to record the pronounced knocking behaviour of this class of compounds

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[1] Cf possibly Withrow and Rassweiler, *J Ind Eng Chem*, December, 1933

Three Discharges of Ball Lightning

At 4 15 p m on January 11, the phenomenon of ball lightning occurred at the house of Mr Joseph M. Wreath, Ballymoney, Co Antrim

A first ball exploded against the corner of a metal-bound tea chest just inside the wide open door of a coach-house in a walled-in yard attached to the dwelling-house A second exploded a minute or two later against a ladder leaning against the same coach-house A third entered a ground floor room of the dwelling-house, having come down the chimney against the up draught due to a fire burning at the time It exploded in the fireplace.

The balls outside were seen by Mr. Wreath and a friend, who describe them as orange-red and as being of about the size and having the velocity of a cricket ball That indoors was seen by two ladies

A wireless aerial is attached to the chimney stack by which the third ball entered the dwelling-house

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Research Items

Mohenjo-daro. The Sir George Birdwood memorial lecture of the Royal Society of Arts delivered on December 8 by Dr. E. H. J. Mackay (see NATURE, 132, 960, Dec. 23, 1933) is published in full in the Society's *Journal* of January 5. The objective of the six years' excavation under Dr. Mackay from 1927 to 1933 was to establish the cultural history of the city in the period represented by the lower strata. Attempts were made to reach virgin soil, but these had to be abandoned at a depth of 43 ft. below the surface of the mound owing to the seepage of water from the Indus. The earliest remains of the city must be regarded as irretrievably lost, failing the employment of expensive pumping operations. The city from the earliest times was laid out in rectangular blocks of remarkable accuracy, the streets running at right angles. Excavations have been carried down to six levels of occupation, the finest and most carefully laid masonry being found in the early levels. Houses were well built up to the end of the Intermediate Period, when signs of economy appear and walls were made thinner. Houses were of two or more stories, the upper being reached by brick staircases. The drainage system is the most elaborate of any city of the same date even outside India. In the last two phases, when the wealthier population had left the city owing to floods, houses were roughly built and those of the *DK* mound were occupied by artisans. The city at this time was apparently exposed to raids from hill tribes, as skeletal remains have been found of inhabitants who had suffered a sudden and violent death. The skulls fall into two classes, Mediterranean and proto-Australoid, one showing a Mongolian strain. Cultural affinities with Mesopotamia, the results of trade, point to a date 2750–2500 B.C. for later strata and about three hundred years earlier for the lower levels. The highest art of the people is shown in the cutting of seals, the subjects affording valuable evidence of their religious beliefs. They appear to have been of western Asiatic origin, but there is at present nothing to indicate the date or route of their entry into India.

Jungle-Fowls from the Pacific Islands. The origin of the jungle-fowls of Polynesia, whether from wild individuals imported from Asia or from varieties already domesticated, is uncertain; but, on the whole, the probability lies with the former suggestion. If that be so, then the great variety of the Pacific races, now living in a feral state, must be due to changes which have taken place since the introduction of the wild species, probably long before Wallis and Cook discovered the natives of the Tuamotus and Tahiti using the birds for food, in 1767 and 1769. Stanley C. Ball, in a monograph of the Pacific Islands forms, points out that, compared with the wild *Gallus gallus*, they are on the average considerably larger, and their variation in size greater (*Bull. Bernice P. Bishop Museum*, 108; 1933). Variation appears to have been greater in the Society and Marquesas archipelagos than in Fiji and the New Hebrides. In the western groups, white spotting is the single remarkable variation, whereas the Marquesas has a red strain with feathered tarsi and yellow-backed males, and in the Society Islands, white-backed males, melanic cocks and hens, white-laced hackles, mingle with the wild type. But all the birds, everywhere, are single-combed.

Scottish Tunicates. Dr. Harold Thompson continues his studies of tunicates in his paper "The Tunicates of the Scottish Area, their Classification, Distribution and Ecology. Part 3. Sedentary Tunicata (continued) Order Diktyobranchia" (Fishery Board for Scotland. Sci. Invest. 1932. No. 2, 1933). Mainly based on records from Scotland, the work represents a thorough overhauling of the groups dealt with, which in the present part include the Rhodosomatidæ, Ascidiidæ, Perophoridæ and Cionidæ. In a paper by Lindsay and Thompson (*J. Mar. Biol. Ass.*, 17, 1, 1930) the author has already inquired into the determination of specific characters in the family Ascidiidæ, in which it was suggested that the three recognised genera *Phallusia*, *Ascidia* and *Ascidiella* of Roule might be combined. In the present paper the same combination is kept, and with the genus *Ascidia* are merged both *Ascidiella* and *Phallusia*. There is a very large list of new Scottish records given for *Ascidia scabra* as distinct from *A. aspersa*. Within the order Diktyobranchia there are two species typical of arctic conditions, two of arctic and north boreal conditions, eight typical of boreal conditions and two of south boreal conditions. The boreal species tend to be confined to the Mediterranean and east Atlantic boreal regions, and, with the exception of *Ascidia scabra*, *Ciona intestinalis* and to some extent *Ascidia virginea* and *Ascidia conchilega*, tend to fail in North Sea water proper.

Tidal Bores. In the *Geophysical Supplement* (vol. 3, No. 5) to the *Monthly Notices of the Royal Astronomical Society*, Dr. Vaughan Cornish describes observations made by him on tidal bores on the Severn and Trent. The paper is non-mathematical, but the observations are quantitative, and made with the view of providing data on which can be based an adequate mathematical investigation of the type of bore most characteristic of English and French rivers. In this type the steep slope of the head of the tide breaks up into a group of short waves. In his observations on the Trent, during the years 1922–28, Dr. Cornish observed the same bore at different points up the river, travelling from point to point by motor-car, outstripping the bore. He observed not only the changes in form of the bores when rounding bends, and across points where the river depth changed rapidly, but also in passing the mouth of a canal opening on to the Trent. He urges the need of a co-operative study of the Trent bore, by a group of students equipped with tide-gauges, current meters and kinematographic cameras.

Low Temperatures by Adiabatic Demagnetisation. De Haas, Wiersma and Kramers describe (*Physica*, 1, Dec. 1, 1933) the experiments which have led to the lowest temperatures yet attained. A quantity of a paramagnetic salt is cooled by liquid helium and kept for some time in the field of a large electromagnet. The field is then suddenly reduced, and the demagnetisation of the salt under approximately adiabatic conditions causes its temperature to fall. The specimen is arranged to lie in an inhomogeneous magnetic field and the mechanical force on the specimen is measured by a balance, so that its susceptibility may be determined. The magnetic susceptibility is used to provide a scale of temperature which is extrapolated below the temperatures measured with liquid helium. The salts used were cerium fluoride and the ethylsulphates of cerium and dysprosium. In an experiment recorded in a footnote potassium chrome alum was used, and gave the lowest temperature—below 0·05° K. (see also NATURE, 132, 372, Sept. 9, 1933).

Oxidation and Condensation of Phenols. The *Proceedings of the Royal Society* of December contains a set of papers by H. G. H. Erdtman on the oxidation and condensation products of phenols. It seems probable that the complicated substances called 'humic acids' possess an aromatic structure and that they are produced by the coupling of quinonoid molecules. The first part of Erdtman's work is the investigation of the reactivity of some simple monocyclic quinones in the light of Lapworth and Robinson's application of the electron theory of valency. According to this theory, the reactivity of unsaturated molecules may be explained in terms of the 'polarisation' of parts of the structure. The reaction studied experimentally was the acetylation of the quinines with a mixture of acetic anhydride and sulphuric acid, and the reactivity of the various quinones showed a fairly good agreement with the predictions of the theory. The theory also suggests a mechanism for the coupling of carbocyclic rings during the oxidation (dehydrogenation) of phenols. A typical example is the formation of a hexahydroxydiphenyl on the oxidation of pyrogallol in baryta solution, and a whole series of such couplings was investigated. During the work, an investigation of the polymerisation of toluquinine led to the discovery of a termolecular condensation product, and a termolecular product was also obtained from benzoquinine, though in this case further polymerisation leads to a poor yield; α-naphthaquinone yields more crystalline termolecular product than toluquinine.

Medieval Glass. Very little information is available on the chemical composition of medieval glass, although this is obviously an important criterion of the genuine nature of particular specimens. A detailed account by M. Chesneau (*Bull. Soc. d'Encouragement pour l'Industrie Nationale*, 132, 609; 1933) of the chemical analyses of French window glasses of the twelfth and thirteenth centuries is therefore of considerable interest. These glasses contain less silica and more alkali (potash and soda) and alkaline earths (lime and magnesia) than modern glass, the mean percentages being 70 per cent silica, 17 of alkali (soda) and 13 of lime, and are therefore more fusible and more easily attacked by moisture and atmospheric carbon dioxide, although the actual specimens were well preserved. The addition of common salt during fusion, as mentioned by Agricola, is considered probable, since the proportion of soda to potash in the glasses is larger than could be accounted for by the use of wood ashes alone, as specified by Theophilus. The probable method of working is fully described, the glass being first blown, and the pear either pierced and spun or worked into a cylinder, afterwards cut and opened out. The glass had been decolourised by addition of pyrolusite and the colours were due to metallic oxides, the red glass, however, being formed by a thin sheet of red superposed on or interposed between colourless glass. The red was coloured with cuprous oxide; the blue with cobalt with traces of cupric oxide and having a grey tone owing to the presence of nickel; the yellow contained antimony oxysulphide with some ferric oxide; the violet had oxide of manganese (pyrolusite) together with some ferric oxide, giving the flesh tint of all ancient violet glasses; and the green contained cupric oxide. The cobalt mineral in all probability came from Saxony, the other minerals being native in France.

Transient Waves on Transmission Lines. The importance of preserving the best possible continuity of supply on electric transmission lines has led engineers to study the effects produced on them by transient or 'travelling wave' phenomena. A great many experimental and theoretical researches particularly in the United States have now been published on this subject. The waves are caused mainly by lightning, but sometimes a fault connecting the line to the earth by an arc, or even switching operations will cause them. In a paper read to the Institution of Electrical Engineers on January 4 by Dr. J. L. Miller, the influence of these waves on electrical devices is discussed. Dr. Miller states that lightning is practically always the cause of dangerous over voltages. American experimenters have shown that lightning surges can cause a pressure rise of about seven or eight times the normal voltage. In one particular case careful records were kept of the disturbances occurring on five different transmission lines over a period of five years. It was found that one per cent reached fifteen times normal line voltage, five per cent reached eleven times normal line voltage and ten per cent reached eight times this voltage. Altogether, nearly 700 surges were recorded and 73 of them were more than eight times normal. It is concluded that a line at the British grid pressure of 132 kilovolts would, if placed in this district, be liable to three surges per annum of the order of a million kilovolts. It will be seen that transformers and other electric devices would have to operate under dangerous conditions. An oscillogram has been obtained which shows a surge which rose to five million volts in less than two microseconds. The author gives a fairly complete mathematical theory and checks it by showing high-speed cathode ray oscillograms of the phenomena. He has explored a very wide field about which opinion is still divided.

The Support of the Chromosphere. A novel theory of the manner in which the chromosphere is supported has been put forward by Dr. S. Chandrasekhar (*Mon. Not. R.A.S.*, 94, No. 1, November 1933). The difficulty of accounting for the enormous extension of the chromosphere was first met by Prof. E. A. Milne, who suggested that the calcium atoms were supported by selective radiation pressure. It has also been suggested that turbulence is a cause of the behaviour of the chromosphere. Dr. Chandrasekhar has extended Milne's theory in a very interesting way. Guided by the observed granular appearance of the solar disc, he discards the notion of hydrostatic equilibrium, and introduces instead the hypothesis that the chromosphere is in a hydrodynamically steady state. The mean flux of radiation corresponds to full support of the chromosphere, and atoms over bright areas are accelerated outwards, while those over the darker patches tend to fall back. The theory predicts for the outward march of the density gradient a law which keeps numerically close to an exponential law.

Elementary Science in Secondary Schools

IN a consideration of the School Certificate Examination, the Panel of Investigators appointed by the Secondary School Examinations Council reported in 1932* that so far as science is concerned, the examination was unsatisfactory. There are fifteen possible ways that a candidate for School Certificate may be examined in science, no examining body having less than five possibilities. By taking advantage of the possibilities offered, a candidate may under some examining bodies offer for a science pass in School Certificate, either heat, light and sound, or magnetism and electricity, without any other science subject. While this is possible in only three out of the eight examining bodies, in all cases a candidate need only offer one science, usually chemistry, physics or botany, in order to pass in science. The concentration thus demanded on a single science subject in the school examination is not regarded as in the best interests of the pupil or of science, in that it is impossible to achieve any satisfactory training in scientific method by a consideration of any one single science, and that also such a procedure does not give to the pupil a sufficiently comprehensive idea of what is connoted by the term 'science'.

These disadvantages, to which the Panel of Investigation directed attention, have been realised by some examining bodies, and attempts have been made to suggest broader conceptions of science in examinational syllabuses. Thus general physics, physics cum chemistry (under various names), biology, and general science have been introduced as alternative papers. The general physics paper is a purely qualitative paper, covering superficially almost the same ground as the normal physics paper, the physics cum chemistry paper is usually resolvable into a 'test on a little chemistry plus a truncated course in physics"; the biology, while obviously a better introduction to life sciences than either the single subjects of botany or zoology, is usually tested by a paper divided into two sections, one botanical and the other zoological, "with little to suggest that the paper is dealing with the phenomena of living things as a whole". The most successful has been the general science paper, which, however, has been subjected to the criticism of superficiality.

These particular criticisms are made by the Investigators as a corollary to their general criticism of the connexion between School Certificate and Matriculation. The original intentions† of the School Certificate Examination were to "test the results of the course of general education", and to be suitable for forms in which the average age of the pupils ranges from about 16 years to 16 years 8 months, and that "the standard for a pass will be such as may be expected from pupils of reasonable industry and ordinary intelligence in an efficient secondary school", and it was only intended secondarily to act as a qualifying examination for entrance to universities. There is no doubt, however, that these original intentions have become obscured, and the university entrance qualification has become predominant, Matriculation being regarded as a superior kind of School Certificate by both candidates and employers. The Investigators note the number of students entering universities from State-aided secondary schools in England and Wales in 1930–31 as 4,132, whereas the number of candidates who qualified for matriculation in the School Certificate examinations conducted by London and the Northern Joint Board in July and December, 1931, was 11,119; in other words, considering all possibilities, not more than one in four of the pupils in State-aided schools who "matriculate actually proceed to a University". Hence arises the much condemned university domination of the secondary school curriculum.

These lines of criticism of the secondary school examinations agree with the new tendency of the secondary school to regard its pupils as potential citizens and laymen, and not necessarily as potential specialists in science or any other subject. In other words, the modern secondary school is beginning to face towards the practical world of the ordinary citizen and away from the necessarily narrow academicism of the university specialist. The secondary school curriculum is being recast to bring it in line with the requirements of intelligent laymen living in a modern world.

This broadening tendency is making itself most manifest in the school science syllabuses. Thus it was agreed at the annual meeting of the Science Masters' Association on January 4 "That there is a general body of scientific knowledge not confined to either of the special fields of the physical and biological science which ought to be known both by the ordinary citizen and by those who may ultimately specialise in some corner of one of those two fields". This broader aspect of science is being termed 'Elementary Science' in order to avoid confusion with existing syllabuses designated 'General Science' and 'General Elementary Science', which, although an approach in the required direction, suffer from certain defects, criticisms, and traditions that it is hoped 'Elementary Science' may avoid.

A sub-committee of the Science Masters' Association in a recent report, defines 'Elementary Science' as "a method of presenting the fundamental principles of science based on the interpretation to youth of the world in which he lives, involving not only an understanding of those fundamental principles, but also of the attitude and method of science generally. Science is here regarded as a living whole, comprehending all the sectional sciences necessary to give youth an intelligent understanding of his biological, chemical and physical surroundings".

It is emphasised that the value of such science to the pupil lies not only in a wide appreciation of his biological, chemical and physical environment, but also in an understanding of the characteristic attitude and methods of the scientific worker. Moreover, 'Elementary Science' places the needs of the pupils before the demands of any sectional science, its essence lies not so much in the syllabus, the content of which must be selected and organised according to the actual environment and needs of the pupils, as in the interpretation of it as a method of explaining that environment. Its content must, of course, include the three fundamental sciences of biology, chemistry and physics, but the proportions of each are determined not by their relative importance as sciences, but by the extent to which they each contribute to the environment

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* The School Certificate Examination. (H.M. Stationery Office, 1932.) See NATURE, 131, 217, Feb. 18, 1933.

† Board of Education Circular 849 and subsequent circulars.

In order to meet the criticism of superficiality and triviality to which all broad schemes of science teaching are subject, the sub-committee referred to has drawn up not only a suggested syllabus, but also a list of fundamental principles of science, the application of which is of fundamental importance in the life of the ordinary citizen, and towards a knowledge of which it is felt that any course of elementary science, whatever its content, should aim These fundamental principles presented as the aims of the new subject need, and it is hoped will get, criticism and correction by scientific workers, laymen and all interested in educational matters

It is realised, too, that there are many practical difficulties of method, organisation and teaching, particularly where teachers are by their training of necessity specialists, but it is felt that with a clear statement of aim and policy, these difficulties will not be insuperable.

What is more controversial is the recommendation of the Investigators, which was agreed to by the Science Masters' Association at the annual general meeting, to make an examination in this subject of elementary science compulsory for all School Certificate candidates, unless they offer all three science subjects, biology, chemistry, physics But it is felt that, while no brief is held for examinations, as such, so long as they exist they do largely influence the curriculum of the schools, and unless the subject of elementary science, like English and mathematics, is made compulsory, it will not receive serious consideration in competition with other subjects of examinational value Moreover, much as compulsion is disliked, it is pointed out that compulsion for the science candidate virtually exists at the moment, but confined to a very narrow field of one science, or part of one science The result of the adoption of compulsory elementary science in School Certificate would broaden both the examination and the school curriculum and thus be of most benefit to what, after all, should be the paramount consideration—the needs of the ordinary pupil F W TURNER.

Patents and Inventions

THE Institution of Mechanical Engineers has recently formed an Inventions Advisory Committee with Mr W Taylor as chairman In connexion with the inauguration of this Committee, on January 26 a meeting of the Institution was held when four short papers were read dealing with invention and inventors These papers were "The Evolution of Invention", by H. W. Dickinson, "The Inventor", by Dr H S Hatfield, "Provisional Patent Protection and Patent Claims", by Sir William Jarratt and "The Development and Exploitation of Inventions", by A H. Gledhill.

The subject is a vast one, for as Mr Dickinson said, "All social, economic, physical, technical, and commercial developments are the result of invention, and we may say that civilization is a synthesis of the inventions made by man since his appearance on this planet a million years ago" The word invention to day has three meanings · (1) the thing schemed or contrived, (2) the mental processes involved, and (3) the ability to evolve the new scheme or contrivance, commonly called inventiveness As regards the encouragement of invention, England furnishes the first known instance of encouragement being given to the producer of a new process, for in 1440 (18, Henry VI) Letters Patent were granted by the Crown to John of Schiedam and his company for a method or process of manufacturing salt. It was, however, the Statue of Monopolies of 1624 which formed the basis of our present patent systems

Dr Hatfield seems to consider the technical inventor to be a new figure in the history of mankind, but it is doubtful whether this view is correct The ships, the aqueducts, the tunnels and the buildings of the Romans were the result of the accumulated inventions of the day, and these would have undoubtedly been followed by others had not the Empire been overwhelmed by the barbarians of the north In concluding his contribution to the symposium, Dr Hatfield attempted to define the mental characteristics which distinguish the successful inventor.

While the papers of Mr Dickinson and Dr Hatfield referred largely to the philosophy of invention, those by Sir William Jarratt and Mr. Gledhill discussed the position of the inventor and of patent legislation to-day Sir William Jarratt congratulated the Institution on the formation of a Standing Committee to consider inventions submitted by members Some years ago, he said, he served on a committee appointed to consider the best method of dealing with inventions made by Government servants, and through the report of that committee each of the great Departments of State has now an Awards Committee, with power to recommend monetary awards for inventors If industry in Great Britain is to maintain and improve its position in the world, it will be necessary that discovery and invention shall continue to be encouraged by public and private benevolence, by research scholarships, by a sound system of patents and by the work of committees such as that of the Institution of Mechanical Engineers

The last paper, that by Mr Gledhill, dealt concisely with the commercial development of inventions, the sale of the products of an invention and the manufacturing of the product of an invention Incidentally, he mentioned that the Patent Office made a net profit of £146,000 last year, and he suggested that a portion of this might wisely be used to encourage developments of inventions which would benefit the country. It might also be proposed that some of this profit be used to improve the conditions under which the examiners work and for the upkeep of the library, where many books are in need of rebinding and where a system of vacuum cleaning would be advantageous. It may indeed be doubted whether an increase in the facilities for inventors and a reduction of their fees is not a sounder national policy than to look to the Patent Office as a source of revenue

That there is a need for a continual revision of the patent laws was suggested by several of those who took part in the discussion of the papers The general interest shown in the discussion is a good augury for a new departure of the Institution, which as the chairman, Col A E. Davidson, said, is justified by its Royal Charter, which states that one object of the Institution is "to encourage invention and research in matters connected with mechanical engineering"

The Piezo-Electric Loud-Speaker

MODERN broadcasting receivers tend to give an undue response to the lower audio frequencies, and in the majority of cases the range is limited to frequencies below 5,000 cycles per second. This is partly due to the fact that the lower frequencies, which at one time were not reproduced very well, have now become attractive as lending power and tone to the reproduction, but it is also due to the demand for increased range in distant reception, for which purpose a high selectivity is required, a virtue which is most easily attained by reducing or eliminating the higher frequencies. Compensation for this latter deficiency can be obtained to some extent by using tone correcting arrangements in the audio-frequency stages of the receiver, but the effect of these in the sound reproduction is rather handicapped by the poor response of the moving-coil type of loud-speaker to the higher audio frequencies.

A solution of this difficulty is now in view in the form of the piezo-electric loud-speaker, an investigation of which has been described in a paper by Stuart Ballantine, of the Boonton Research Corporation, U.S.A., published in the *Proceedings of the Institute of Radio Engineers* of October 1933. The loud-speaker employed in these measurements was of the horn type and was driven by a piezo-electrically active diaphragm built up of crystals of Rochelle salt (sodium potassium tartrate), prepared by the Brush Development Company of Cleveland, Ohio. The diaphragm is formed of four pairs of crystal plates, the plates of each pair being so cut that they move in opposite directions under the influence of an electromotive force. The opposite faces of such a pair of plates are cemented together, and the combination, when clamped along one edge, tends to twist on the application of a potential difference to its foil electrodes. Four such units are cemented together to form a flat square diaphragm, which is clamped around its periphery, so that in use the centre portion or junction of the four units vibrates normally to the plane of the assembly, and in synchronism with the audio frequency electromotive force applied to the metal foil electrodes.

The characteristic of this type of loud-speaker, that is, the relation of output sound pressure to frequency, can be controlled to some extent by the electrical circuit in which it is used and also by the resonant frequency of the crystal diaphragm, which depends upon its dimensions. In an example illustrated in the above paper, the sound pressure rises fairly uniformly with frequency from about 1,000 cycles per second to the resonant value at 8,000 cycles per second. This characteristic may be partially levelled off by suitably connecting it to an electrical circuit, and in a second case in which the loud-speaker was fed through a transformer in series with an inductance, the sound output, after increasing rapidly between frequencies of 1,000 and 2,000 cycles per second, remained sensibly uniform for higher frequencies up to 10,000 cycles per second. This type of response immediately suggests the possibilities of a combination of a piezo-electric loud-speaker with one of the moving-coil type, in which the output is moderately constant for low frequencies but falls rapidly above the cut-off frequency. Ballantine describes such a combination using a moving-coil loud-speaker which has been designed for uniform reproduction up to 3,000 cycles per second, with a rapidly falling response above that frequency. The combined output is shown to be approximately uniform at all frequencies between 60 and 9,000 cycles per second. Such dual arrangements have the advantage that the response can be limited to that of the low-frequency member of the pair if considerations of noise or transmission interference make this desirable.

The piezo-electric loud-speaker also forms the subject of an article in the *Wireless World* of January 5, in which the development in Great Britain, by the Rothermel Corporation Ltd., is briefly described and illustrated. In this case the crystal unit is built up of four laminations, approximately 2½ in. square, the total thickness being ¼ in. Three of the corners of this assembly are clamped between rubber blocks, and the vibration of the fourth corner is used to drive the cone diaphragm. The equivalent capacity of this unit is of the order of 0·03 mfd., and it is suitable for use in conjunction with an ordinary moving-coil output transformer. The efficiency of the unit appears to be very good, particularly in the frequency range 2,000–8,000 cycles per second, while in combination with a standard type of permanent moving-coil loud-speaker the quality of reproduction is claimed to be superior to that hitherto obtained with commercial dual moving-coil units.

Larval Crabs from Japan[*]

DR. HIROAKI AIKAWA has recently supplemented his first paper on the newly-hatched crab zoeas of Japan (1929) with one on the intermediate (later zoeal) stages between the first zoea and the megalopa. Crab zoeas of all kinds are very common in the Japanese plankton, but few of them have been traced to the adults, and the author has devised a distinctly helpful scheme for placing them in groups characterised by definite features. Recent research by other workers has shown that there are several larval characters by means of which the various natural divisions can be recognised; the Oxyrhyncha can be divided from the Brachyrhyncha and many of the families and genera can be identified, whilst by rearing the individuals several species are now known throughout the whole life-history. The Dromiacea always stand apart and should certainly be separated from the Brachyura.

The most important features which can be used in classification are the number of spines on the carapace, the form of the antennæ and the number and position of the spines on the telson. Dr. Aikawa uses the position on the body of the main chromatophores, but these are no good in long-preserved material. Besides elaborating the classification of the antennæ and telson, he now adds the establishment of a hair formula for the endopodite of the two maxillæ and of the second maxillipede and of the joints of the latter, which he finds are constant for the species through all the zoeal stages. He has established nine groups of zoeas based on the form of the antennæ and telson by the aid of which any unknown zoea of any stage may be classified approximately, but the classification is admittedly not a natural one For example, the group Inachizoea is typical for the Inachidæ, but also contains *Pilumnus*, *Heteropanope* and *Gonoplax*, whilst the group Grapsizoea, although one type is chiefly confined to the grapsoid crabs, contains another type in which are included many of the Portunidæ, also *Thia*, *Eriphia*, *Hyas* and *Maia* , nevertheless, with the further and more exact descriptions of the individual zoeas, one can get a very good idea of their probable position in a natural classification and comparing it with those the adults of which are known, many genera can already be identified

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[*] *Records of Oceanographic Works in Japan*, 5, No. 2, June 1933. "On Larval Forms of Some Brachyura". (2) "A Note on Indeterminable Zoeas", by Hiroaki Aikawa.

The system of groups here given is to be regarded as a kind of key which is really helpful and a distinct step forward in the elucidation of the difficult brachyuran larvæ Several zoeas are described and figured, none of which can be actually referred to any known species, but they are classified into these groups It is possible, however, from the characters given to place them at least in the families if not in the genera to which they belong.

It is hoped that in the near future the author will produce a similar grouping for the megalopæ, which is much wanted

University and Educational Intelligence

CAMBRIDGE —Prof Werner Heisenberg, of the University of Leipzig and Magdalen College, Oxford, has been appointed Rouse Ball lecturer for the year 1933–34.

At Queens' College, Prof James B. Buxton, professor of animal pathology in the University, has been elected to a professorial fellowship

LONDON —The University is making a grant of £100 towards the fund for the purchase of the "Codex Sinaiticus"

A course of six lectures on cytology will be given at University College, Gower Street, London, W C.1, on Wednesdays commencing on February 7, at 5 p m by Dr R J Ludford, Dr E. S. Horning and Dr K C. Richardson. The lectures are open to the public.

OXFORD —On Tuesday, January 23, Congregation approved an amending Statute for defining more exactly the scope of the Hope professorship of zoology, by adding ("Entomology") to the designation of the professorship, and to the mention of "zoology" wherever it occurs in the statement of the professor's duties

At the same meeting of Congregation, the Master of Balliol, in moving the preamble of a statute for extending and improving the provisions for the study of forestry in the University, directed attention to the fact that the clauses of the statute, if they were deemed unacceptable, were open to revision by amendment at a later stage. The same point was urged by Dr. N. V. Sidgwick. Prof. F. A. Lindemann, though refraining from opposing the passing of the preamble, thought that the statute in its present form provided no sufficient guarantee for ensuring the permanence of grants. The preamble was carried without a division.

Prof. W. G Le Gros Clark, professor of anatomy at St Thomas's Hospital Medical School, University of London, has been appointed Dr. Lee's professor of anatomy

On Tuesday, January 30, Congregation approved the preamble of a statute establishing a statutory readership in physical anthropology. The Senior Proctor, Mr H. G Hanbury, of Lincoln College, explained that the duties of the post had been voluntarily undertaken by the former Lee's professor of anatomy , and that the present measure was called for in consequence of the recent retirement of Dr Arthur Thomson from the professorship

The honorary degree of M A was conferred on Miss Ethel Bellamy in recognition of her work at the University Observatory on the photographic chart of the heavens

Science News a Century Ago

The King's Speech, 1834

February 4, 1834, saw the opening of Parliament, and amongst the items dealt with in the Speech from the Throne (Earl Grey, Prime Minister) was a mention of the Act passed in the previous session abolishing slavery under the British flag Legislation dealing with the status and power of municipal corporations was forecast (but was not passed until 1835) The Speech lamented the continued distress amongst the proprietors and occupiers of land, and Parliament was recommended to give early consideration to such a final adjustment of the tithes as may extinguish all just causes of complaint On the subject of Ireland the Speech contained the following passage "But I have seen with feelings of deep regret and just indignation the continuance of attempts to excite the people of that country to demand a repeal of the legislative union".

Porcupine Men

During January 1834, a middle-aged man, of very athletic and robust form of body, completely covered with a green horny substance in the form of quills, not dissimilar to those which are produced on the porcupine, presented himself at the Westminster Hospital for exhibition The parts which had escaped the deformity were his face, the palms of his hands and the soles of his feet , every other part of his person was abundantly supplied with this green horny substance He stated that he shed his horns, or quills, annually, and a fresh crop succeeded

A description of the case appears in the *London Medical and Surgical Journal* of February 6, 1834 The man was a member of the celebrated Lambert family, in which this remarkable condition, an extraordinarily scarce form of the skin disease named ichthyosis hystrix, was present in at least six generations. In every case the condition appeared about two months after birth and affected the males only The case of the first member of the Lambert family to be affected was reported to the Royal Society on March 16, 1731, by John Machin, the secretary, and Prof. Gresh (*Phil. Trans* , 38, 299 ; 1731) at fourteen years of age, and in 1755 at the age of thirty-eight with his son Edward by Baker (*ibid.*, 49, 21; 1755). Edward and his two sons, who all presented a similar skin condition, visited Germany and France, where they were described under the name of "Porcupine Men" by Blumenbach, Autenrieth and Tilesius. Other members of the family similarly affected were afterwards described by Elliotson in 1831, Pettigrew in 1834 (in the subject of this note) and by Pickells in 1851 Further details concerning the Lambert family, including a reproduction of the figure published in 1802 by Tilesius, will be found in E A Cockayne's "Inherited Anomalies of the Skin and its Appendages" (1933), pp 182–85, from which most of the above information is taken

The Franklin Institute

At the beginning of the nineteenth century, Philadelphia was the centre of scientific culture in the United States The American Philosophical Society had been founded in 1769, with Franklin as its first president, while in 1814 and 1824 respectively, the Academy of National Sciences of Philadelphia, and the Franklin Institute of Pennsylvania were inaugurated. The latter society had its birth at a meeting held in the County Court House on February 5, 1824, when it was resolved that "it is expedient to form a Society for the promotion of the useful arts in Philadelphia, by extending a knowledge of Mechanical Science to its members and others at a cheap rate" It was also resolved to attain this object by means of lectures, the formation of collections and of a library and the award of premiums for inventions The Institute held its first public exhibition in October 1824, its first hall was erected in 1825, and the following year the *Franklin Journal* was established Two years later this was renamed the *Journal of the Franklin Institute*, by which title it has since been known

From the first the *Journal* contained original contributions, reprints from other periodicals, reports of committees and notices of American inventions The annual report of the Board of Managers submitted in January 1834 was signed by Alex Dallas Bache At that time there were 1,659 members, and "the condition of the Institution was one well deserving mutual congratulations From a small beginning, in an attempt to diffuse useful knowledge, to promote practical science and the mechanic arts, the institution had grown to be respected by her members and the public" The report refers to courses of lectures by Prof J K Mitchell on chemistry, by Prof W R Johnson on natural philosophy and by Gouverneur Emerson, M D, on meteorology Thanks were expressed to these lecturers and also "to J Millington, Esq, late Professor of Natural Philosophy in the Royal Institution of London who is engaged on a most able series of lectures on astronomy". The society at that time was investigating the principles of water wheels, inquiring into the causes of the numerous explosion of boilers in American steam boats, and the *Journal* for 1833 and 1834 contains reports of various individuals into the system of weights and measures of the United States, England and France Its important work in this direction was recognised by the Pennsylvanian Government, and on the instructions of the House of Representatives the secretary of the Commonwealth had forwarded to the Institute a draft of a bill relating to weights and measures for its consideration

Societies and Academies

LONDON

Royal Society, January 25 A. ZOOND and J EYRE. Studies in reptilian colour response. (1) The bionomics and physiology of the pigmentary activity of the chameleon In strong diffuse daylight chameleons become dark on a black background and pale on a white one Blind animals darken in the light. This response depends upon the integrity of spinal reflex arcs The time relations of these responses have been determined. The threshold for the retinal photoreceptors is lower than for the dermal ones In weak light the white background response is reversed, the animals becoming dark Low temperatures above 0° C have no effect upon the normal response of chameleons to darkness A theory of nervous coordination is developed It is suggested that the 'daily rhythm' of colour changes may be interpreted in terms of the white background response in strong and weak light, without reference to temperature. A WOLSKY and J S HUXLEY The structure and development of normal and mutant eyes in *Gammarus chevreuxi* The eyes of 'eye colour mutants' ('red', 'no-white', etc) differ from normals only in pigmentation and not in structure The eyes of 'eye-structure' mutants ('albino', 'colourless') are markedly deficient as compared with normal For the development of normal eyes, the results of Schatz (1929) are confirmed The differentiation and growth of the optic tract (not previously studied in *Gammarus*) is centrifugal in time the medulla externa and lamina ganglionaris are at first small, but eventually constitute a large and distinct protuberance In the eye-structure mutants the adult optic tract is comparable with the early embryonic stage of normals The structure of albino and colourless eyes can be formally explained in terms of (*a*) a rate-gene causing a delay in differentiation of the organs (optic tract and eye-mass) derived from the primary optic disc, (*b*) a graded distribution of the inhibitory effect caused by this delay, and (*c*) possibly, the consequent absence of a formative stimulus normally exerted by the optic tract upon the differentiation of the eye proper. J. NEEDHAM, C H WADDINGTON, and DOROTHY M. NEEDHAM Physico-chemical experiments on the amphibian organiser The induction of a secondary embryonic axis in amphibian gastrulæ can be accomplished by the implantation of (*a*) cell-free extracts of the neurula, (*b*) ether and petrol-ether extracts of the neurula, (*c*) adult amphibian tissues, (*d*) ether extracts of adult amphibian viscera A distinction is made between two factors in induction, the production of an embryonic axis as such, which is called evocation; and the determination of the regional, for example, antero posterior, character of that axis, which is called individuation The evocator is probably a definite chemical substance soluble in ether and petrol-ether.

PARIS

Academy of Sciences, December 18 (*C.R*, 197, 1545–1705) LOUIS CARTAN The displacement in an electrostatic field of magneto-electronic spirals. N. THON: The direct determination of the number of active centres on a crystalline metallic cathode. E GUILLERMET: The electrolysis of cupric chloride in methyl alcohol solution. The primary reaction appears to be production of cuprous chloride and chlorine. R DE MALLEMANN and H. COURTILLOT. Elliptical reflection at normal incidence on a transparent anisotropic body. The superficial double refraction of Iceland spar. ANTOINE GOLDET: The thermal variation of the magnetic double refraction of nitrobenzene, benzene and carbon disulphide. The experimental results are given as curves, and are compared with those predicted by the theories of Langevin and of R. de Mallemann. TSAÏ BELLING. The magnetic double refraction of gaseous oxygen. Experiments carried out with a field of 45,000 gauss show that compressed oxygen under the action of the magnetic field clearly acquires a negative double refraction proportional to the pressure. J J TRILLAT · Study of the fatty esters of cellulose by means of the X-rays The reticular distances are a linear function of the number of carbon atoms in the esterifying acid HUBERT GARRIGUE · The activity of materials exposed to the natural electric field G GAMOW and S. ROSENBLUM: The effective diameters of the radioactive nuclei F JOLIOT An experimental proof of the annihilation of positive electrons The experiments show that when positive electrons are absorbed by matter, there is observed an emission of photons of energy about 0·5 × 10^6 ev. Hence it is concluded that the process of annihilation of positive electrons imagined by Dirac is confirmed by these experiments FRANCIS PERRIN · The possibility of the emission of neutral particles of intrinsic mass zero in β radioactivity W M. ELSASSER and K GUGGENHEIMER The anomalies in the proportion of the elements and on the origin of the radioactive bodies JEAN THIBAUD The annihilation of positrons in contact with matter and the resulting radiation PAUL MONDAIN MONVAL and MLLE HÉLÈNE SCHLEGEL. The partially miscible pair aniline-water Study of the inversion of density of the two layers · below 77° C the aniline layer is the lower, but above this temperature it is the layer rich in aniline which is uppermost RENÉ PÂRIS. The ternary magnesium-zinc-calcium alloys PIERRE BRUN The volume variations of mixtures of water, ethyl alcohol, ether Additional evidence is given in support of the view previously put forward by the author that the idea of continuity could be extended to the case of the miscibility of liquids V AUGER. The existence of pyro- and meta-arsenic acids Contrary to the views of Rosenheim and Antelman, the author holds that ortho-, pyro- and meta-arsenic acids have so far not been obtained ANDRÉ MORETTE. The action of vanadium tetrachloride upon some anhydrous chlorides HENRI MOUREU and PAUL ROCQUET. The product resulting from the action of ammonia on phosphorus pentachloride The products of the reaction were ammonium chloride, separated by extraction with liquid ammonia, and phosphorus diimidoamide, $P(NH)_2NH_2$ This gives phospham, PN_2H, on prolonged heating in a vacuum at 350° G GIRE Basic sulphate of nickel. L PIAUX The Raman spectra of some cyclanones MLLE DARMON: The isomerisation of the methyl and ethyl ethers of phenylglycide. G LEJEUNE · Some tartromanganic salts R. PAUL: δ-Oxyvaleraldehyde WIEMANN: The duality of Charon's dipropenylglycol Preparation of one of the constituents in the crystallised state. R. CORNUBERT and M. DE DEMO. The possible existence of three αα′-dibenzylcyclohexanones. ANTOINE WILLEMART. Isomeric transformations of the hydrocarbons $C_{42}H_{28}$, isomers of the 1 : 3 . 1′ . 3′-tetraphenyl-1 · 1′-rubenes. Description of a new isomer. Splitting up by oxidation. CHARLES PRÉVOST The halogen-silver complexes of the carboxylic acids. C. ARAMBOURG: The pre-Tertiary formations of the western border of Lake Rodolphe (Eastern Africa) MLLE. D. LE MAITRE. The age of the Chaudefonds (Maine-et-Loire) limestone G BORGNIEZ The possibility of the existence of periods with a desert climate in the central region of the Belgian Congo. MAURICE BLUMENTHAL The autochtony of the Penibetic in the province of Cadix (Andalusia) ROBERT LAFFITTE The continental formations of the Tertiary of Aurès (Algeria) A VINOGRADOV The elementary chemical composition of living organisms and the periodic system of the chemical elements Discussion of the relation between the quantity of atoms of a chemical element found in living material and the atomic number of this element. A. GRUVEL and W BESNARD · Researches on the nature of the sea floor of the western coast of Morocco between Cape Cantin and Cape Ghir. HENRY HUBERT The aerial currents in Cochin China C E BRAZIER and EBLÉ The temperature of the air in the neighbourhood of the soil The ordinary method of taking ground temperature is shown to be defective · details of an improved method are given. P. IDRAC The influence of the *Mistral* and of the east wind on the temperature of the submarine layers on the Côte d'Azur. R. GUIZONNIER. Phase of the semi-diurnal component of the gradient of electric potential G GRENET: The electrical conductivity of the air at Mont-Dore in August 1933 The mean electrical conductivity observed was about double that usually observed elsewhere The altitude is insufficient to explain this result and the most probable cause would appear to be the hot springs near by and the enclosed form of the valley G DAUZÈRE The spots most frequently struck by lightning in the Department of Aveyron PIERRE CHOUARD: The intervention of the epidermis in the formation of small bulbs on the green leaves of the Liliaceæ H COLIN and E GUÉGUEN. The floridoside in the Florideæ. Floridoside, containing a molecule of glycerol and one of α-galactose, previously isolated from *Rhodymenia palmata*, is now proved to be present in a large number of Algæ. MME HUREL-PY: The possibility of dehydrating the vacuoles of the pollen of *Nicotiana Alata*. E and H BIANCANI and A DOGNON The intervention of thermal phenomena in the biological action of ultra-sounds. E. LEDERER · The carotenoids of a red yeast, *Torula rubra* Four substances are present in this colouring matter, two of which have been isolated; one is β-carotene, the other a new pigment, torulene E FLEURENT The genetics of wheat and the process of bread-making M LEMOIGNE and R. DESVEAUX The influence of the origin of the microbial strains on the balance of nitrogen capable of determination by Kjeldahl's method in aerobic cultures. CH HRUŠKA. Vaccination against the *rouget* of pigs with the non-attenuated bacillus. G. RAMON and MLLE B. ERBER: The presence of the diphtheric antitoxin, of natural origin, in the monkey MAX ARON: The presence, in the urine of subjects with malignant tumour, of a principle capable of acting on the suprarenal cortex.

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[1] Continued from p 151

MELBOURNE

Royal Society of Victoria, October 12. GERALD F. HILL: Australian hemitermes (Isoptera), with descriptions of new species and hitherto undescribed castes This paper contains descriptions of the winged adults of *Hamitermes neogermanus*, Hill, and *H meridionalis*, Froggatt, which were previously known from sterile castes only, and of eight new species **W J Harris** and **D E Thomas**. Geological structure of the Lower Ordovician rocks of eastern Talbot, Victoria The paper deals with the eastern half of the county of Talbot in central Victoria, extending from Castlemaine and Maldon in the north to Kyneton and Daylesford in the south The physiography of the area is discussed, particularly as modified by the lava flows usually referred to as the Newer Basalt A large number of new graptolite localities are recorded and the graptolite zones of the Lower Ordovician rocks have been mapped over about 1,000 square miles The main structural lines in the area trend a little to the west of north and an anticlinorium extending from Maldon to Dean occurs in the west with its eastern limb truncated by the Muckleford fault East of this is the Guildford-Bullarto synclinorium, and the Chewton-Lyonville anticlinorium, and, after a smaller intervening synclinorium, the Taradale-Lauriston anticlinorium The relation of gold occurrences to geological structure is briefly discussed

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, February 5

University College, London, at 5 30—L W G Malcolm "Africa, Past and Present" *

Society of Engineers, at 6—(in the rooms of the Geological Society, Burlington House, Piccadilly, W 1) Inaugural meeting A M A Struben Presidential Address

Royal Geographical Society, at 8 30—Lieut-Col. E R L Peake "The Rhodesia–Congo Boundary"

Wednesday, February 7

East London College, at 5 30—Prof F E Fritsch "Certain Aspects of Algal Biology" (Four succeeding lectures).*

Royal Society of Arts, at 8—Robert R Hyde "The Human Element in Industry"

Friday, February 9

University College, London, at 5 30—Prof Herbert Freundlich "Some Aspects of Colloid Science" (succeeding lectures on February 16, 23, March 9 and 16)

Royal Astronomical Society, at 5—Annual General Meeting Prof F J M Stratton "International Co-operation in Astronomy—a Chapter in Astronomical History" (Presidential Address)

Royal Institution, at 9—Sir J J Thomson "Reminiscences of Physics and Physicists"

Official Publications Received

GREAT BRITAIN AND IRELAND

Lecture on Alchemists in Art and Literature By Richard B Pilcher Pp 64 (London Institute of Chemistry)

British Industries Fair, 1934, Olympia and White City, London, February 19th to March 2nd Organised by the Department of Overseas Trade Special Overseas Advance edition Pp xvi+544+Ads xii+Ads 184 (London Department of Overseas Trade) 1s

Proceedings of the Royal Society of Edinburgh Vol 53, Part 4, No 23 The Mathematical Representation of the Energy Levels of the Secondary Spectrum of Hydrogen By Dr Ian Sandeman Pp 347–358 (Edinburgh Robert Grant and Son, London Williams and Norgate, Ltd) 9d

OTHER COUNTRIES

Scientific Papers of the Institute of Physical and Chemical Research Nos 468–477 On the Sorption of Hydrogen by Reduced Nickel, 1 Determination of the Quantities of Hydrogen adsorbed by and diffused in Pure and Spoiled Reduced Nickel, and Determination of the Isothermal Adsorption Lines and the Heat of Adsorption, by Shun-ichiro Iijima, Studies on Dietary Requirements for Lactation, 1 Failure of Lactation on an apparently complete Synthetic Diet, by Waro Nakahara and Fumito Inukai, Growth of Transplanted Tumors in Albino Rats maintained on a Diet with Protein Hydrolysates as substitute for Protein, by Umetaro Suzuki, Waro Nakahara, Nabetaro Hashimoto and Ryosuke Ikeda, The Influence of Alcohol on the Growth of Transplanted Tumors in Rats, by Umetaro Suzuki, Waro Nakahara, Nabetaro Hashimoto and Ryosuke Ikeda, The Constitution of Resorcine and Acetylacetone viewed from the Raman Effect, by Taro Hayashi, Studies on Thermo luminescence Spectra of Fluorites, Part 2 Division of the Bands in Thermo-luminescence Spectrum of Fluorite into Two Groups, by Eiichi Iwase, On the Sorption of Hydrogen by Reduced Nickel, 2 Adsorption of Hydrogen by Reduced Nickel at Low Temperatures, by Shun-ichiro Iijima; Über die Konstitution der Glucoside, Mitteilung 7 Das Glucosid von *Sanguisorba officinalis*, von Shigehiro Abe und Munio Kotake, On the Surface Free Energy of Liquids and Liquid Mixtures, by Yonezō Morino, Resistance of Impact on Water Surface, Part 4 Circular Plane, by Shumpei Watanabe Pp 285–307+vi+1–135+18 plates 1 25 yen No 478 La likva fazo de portlandcemento je praktika miksproporcio De Tutomu Maeda kaj Ryôzô Syôzi Pp 137-152 20 sen (Tokyo Iwanami Shoten)

Report of the Aeronautical Research Institute, Tôkyô Imperial University No 98 On the Transmissibility of the Visible Light through a Cloud of Particles, Part 3 Scattering of Light from Particles By Daizo Nukiyama Pp 61–100 30 sen No 99 Investigations on the Origin of the Sounds emitted by Revolving Airscrews, 1 Measurement of Pressure-Variations in the Neighbourhood of the Airscrew Blade By Jûichi Obata, Sakae Morita and Yahei Yosida Pp 101–114 15 sen (Tôkyô Koseikai Publishing House)

Mémoires de Musée Royal d'Histoire Naturelle de Belgique Mémoire No 53 Monographie de la Faune malacologique du Bruxellien des Environs de Bruxelles Par Dr Maxime Glibert Pp 215+11 plates Mémoire No 54 Étude de la variation dans la composition de la florule du toit des veines de l'Olive et du Parc des Charbonnages de Mariemont Bascoup Par A Rousseau Pp 30+2 plates. Mémoire No 55 Le genre alveolites Lamarck dans le dévonien moyen et supérieure de l'Ardenne Par M Lecompte Pp 50+4 plates (Bruxelles)

Mémoires du Musée Royal d'Histoire Naturelle de Belgique, Hors Série Résultats scientifiques du Voyage aux Indes Orientales Néerlandaises de LL AA RR le Prince et la Princesse Léopold de Belgique Publiés par V Van Straelen Vol 2, Fascicule 13 I Sipunculiden, von J M A ten Broeke, II Brachiopodes, par E Leloup, III Amphineures, par E Leloup Pp 33+2 plates Vol. 3, Fascicule 13 Holothuries, par H Engel Pp 42+1 plate Vol 3, Fascicule 14 Crustacés décapodes d'eau douce Par Jean Roux Pp 18 Vol 5, Fascicule 3 Poissons By Louis Giltay Pp 129 (Bruxelles)

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft 114 Jahresversammlung vom 1 bis 3 September 1933 in Altdorf Pp 510+8 plates (Aarau H R Sauerländer und Co)

New Zealand Department of Lands and Survey Annual Report on Scenery-Preservation for the Year ended 31st March 1933 Pp 8 (Wellington Government Printer)

Annales de l'Observatoire de Paris, Section d'Astrophysique, à Meudon Publiées par Ernest Esclangon Tome 6 Cartes synoptiques de la chromosphère solaire et catalogue des filaments de la couche supérieure Fascicule 6 Années 1928–1929–1930 Pp ii+85 (Meudon)

Commonwealth of Australia Council for Scientific and Industrial Research Pamphlet No 46 The Holding Power of Special Nails By Ian Langlands (Division of Forest Products, Technical Paper No 11) Pp 30 (Melbourne Government Printer)

Proceedings of the United States National Museum. Vol 82, Art 25 Additional Notes on the Birds of Haiti and the Dominican Republic By Alexander Wetmore and Frederick C Lincoln (No 2966) Pp 68+6 plates Vol 82, Art 27 New Species of Buprestid Beetles from Mexico and Central America By W S Fisher (No 2968) Pp 47 Vol 82, Art 28 Revision of the Beetles of the Genus *Disonycha* occurring in America North of Mexico By Doris Holmes Blake (No 2969) Pp 66+8 plates (Washington, D C Government Printing Office)

Abridged Scientific Publications from the Kodak Research Laboratories Vol 15, 1931–1932 Pp 311+viii (Rochester, N Y Eastman Kodak Co)

CATALOGUES

Direct Reading Universal Compass Pp 8 (London Thorold Drawing Instruments)

A Short List of Second-hand Books chiefly in Natural, Physical Science and Mathematics (Catalogue No 340) Pp 16 (Oxford B H Blackwell, Ltd)

Geographical Books a Bibliographical List of University and School Text and Reference Books prepared for the use of Teachers and Students (No 422) Pp 88 (Cambridge W Heffer and Sons, Ltd)

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Co-ordination of State Scientific Services

IN his recent presidential address to the Royal Society, Sir Frederick Gowland Hopkins referred at some length to the Medical Research Council and its relations to the Agricultural Research Council and the Advisory Council of the Department of Scientific and Industrial Research Stressing the relations which have from their inception existed between the three councils and the Royal Society, Sir Frederick suggested that their creation and the definition of their respective duties and relations had brought into being a great national research organisation, to be viewed as a whole and fully worthy of the confidence of the Society and of Great Britain Although even to-day it is not fully understood by statesmen that endowment of research is among the most profitable of national investments, scientific men are now in real control of scientific policy in Britain even when it deals with enterprises endowed by the State

This reference to the relations which exist between various research councils and research associations deriving part, at least, of their endowment from the State, is welcome in view of certain charges which have recently been brought against them, arising out of the conduct of investigations which are of general interest not only to industry or to social institutions but also to the defence forces of the realm. Two of the most characteristic features of modern scientific development are, indeed, on one hand the extent to which co-operation between different classes of scientific workers—medical men, physicists, biologists, chemists, engineers and others—is again and again required for the solution of a scientific or industrial problem, and on the other, the extent to which discoveries or advances in one field or industry find direct and ready application in many other quite unrelated sciences or industries.

It is accordingly obvious that the Privy Council, under the ægis of which the work of the Medical Research Council, the Agricultural Research Council and the Department of Scientific and Industrial Research is conducted and secured from the dangers of political vagaries and the inhibitions of departmental interference, should take measures to avoid overlapping of effort and the duplication of any expenditure of national revenue. Careful provision has been made to secure adequate contacts within the triad of councils A nexus of responsibilities has been established The three secretaries, for example, are under obligation to meet together on specific occasions for a general discussion of policy, one member at least of the Medical Council must always be on the Agricultural Council, and there are other means of securing co-operation In spite of the diversity of researches and enterprises associated with each of these councils, effective co-ordination has been possible to a remarkable extent The dissolution by the Committee of the Privy Council in 1929 of the three co-ordinating research boards for chemistry, physics and engineering, which were originally established in 1920, is in itself evidence of the success with which research is being co-ordinated

The realisation of the many-sided interests and applications of particular pieces of scientific research undoubtedly led to the adoption of the policy of appointing special *ad hoc* committees from time to time for the consideration of practical problems Such committees are sometimes departmental committees, but the particular department which initiates or bears the responsibility for their work may afford little or no indication of the extent of the interest or application of that work, which might in fact have been equally initiated by several other departments or research organisations

The specific charge has recently been made in "Patriotism Ltd", a publication of the Union of Democratic Control, that the Department of Scientific and Industrial Research has expended a large sum of money on fundamental war research work and on the reorganisation of the research work of the fighting services, and also that the Medical Research Council is similarly financing scientific preparations for war A careful scrutiny of the published reports shows that in actual fact the whole of the expenditure of the Department of Scientific and Industrial Research has been in research work the results of which have been and are available for industry It is similarly true that the Medical Research Council has not since the War period undertaken or financed any researches for purely warlike purposes such as, for example, investigation of the effects of chemical warfare

In view of what has already been said about the general interest of the results of many scientific investigations, it would be highly unlikely that the results of some of the investigations undertaken from purely industrial or medical motives would not have a great interest for some of the fighting services. Equally, in view of the care which any sound administration must take to secure that neither Civil votes nor the Defence votes are used to pay for the same work to be done twice over, it would be surprising to find that no work had been undertaken by the Department of Scientific and Industrial Research or the Medical Research Council at the request of one of the defence services

As a matter of fact, the evidence even of the examples cited in justification of its charges by the publication to which we refer indicates that the converse may equally be true Reference is made, for example, to problems of visual research, on which the Medical Research Council have published a report on "Colour Vision Requirements in the Royal Navy" The results of these investigations, though of special application to service conditions, have also great interest for the merchant marine, the railways, and in relation to road traffic and to some industrial operations

This matter of visual research illustrates a further possibility which criticism has to weigh The Medical Research Council has on occasion availed itself of favourable opportunities afforded by conditions in the defence services for the investigation of problems of interest to the Council This applies particularly in regard to investigations on the value of psychological tests for the selection of personnel for particular forms of skilled work Such investigations are, of course, initiated directly for the assistance of industry The investigations on special aptitudes required in rifle shooting were not undertaken at the instance of the military authorities but of the academic psychologist who did the work, and who saw in rifle shooting an operation combining manual, visual and psychological factors which was particularly suited to his study, and naturally found soldiers the most convenient source of material

Equally it is unfair to charge the Medical Research Council with financing war research when it borrowed special apparatus and trained personnel from the Chemical Defence Research Department for the investigation of the dust clouds that are associated with particular industrial processes and that are likely to be injurious to the workers Similarly, the Council has drawn on the special knowledge of acoustical problems acquired by the Services in relation to anti-aircraft defence to assist its work on the physiology of hearing, which is primarily aimed at the alleviation of deafness.

It is impossible to assess fairly the work of the

Medical Research Council in such matters if constant regard is not paid to the obvious fact that there are few branches of medical research in which new knowledge will not advance military as well as civilian science "Patriotism Ltd" also refers to investigations carried out under the Industrial Health Research Board on the value of psychological tests for accident proneness, in which tests were made on a group of air pilots, naval artificers and dockyard apprentices as well as omnibus drivers The results of some of these tests have already been published in a report by E Farmer, E G Chambers and F J Kirk, on "Tests for Accident Proneness", and they have already been utilised by the National Institute of Industrial Psychology as a basis for a series of practical tests which can be utilised alike for the selection of the best drivers from among a number of applicants, selection of the men most suitable for training as motor drivers, for discovering what is lacking in drivers of poor ability in order to remedy their deficiencies if possible, or for advising those who intend to learn to drive what degree of ability they are likely to develop The value of such practical tests as a means of reducing road accidents is obvious, and the studies upon which they are based are a direct contribution to the welfare of the community, which justifies the use of any available material for its acquisition

The criticism which has been levelled at the Medical Research Council and the Department of Scientific and Industrial Research arises fundamentally from that failure to grasp the passing of the essential distinction between combatant and non-combatant which holds up progress in disarmament If the fundamental lesson of the War years 1914–1918, that under modern conditions war has become industrialised and now involves whole populations and not merely armies, navies or air forces, were widely appreciated, disarmament itself would receive a firmer backing and such criticism as that we have been discussing would never be advanced

There is, however, one point of significance on which the chapter in "Patriotism Ltd" does well to focus attention It would be indefensible if results of civil research held available for use by industry were not also made available for the defence services It would be equally indefensible if work undertaken at the instigation of the fighting services, but not specially paid for by contributions from their vote, were not published and made available for use in industry.

There does not appear to be any reason to suppose that publication encounters any opposition, so far as the researches undertaken under any of the co-ordinating *ad hoc* committees and the like are concerned The Department of Scientific and Industrial Research, however, has initiated a number of co-operative research associations which are financed partly by the Department and partly by the industries concerned These associations, being on a voluntary basis, are by no means completely representative of the industries they serve, and a good deal of jealousy is encountered from time to time on the part of firms which are members of such associations as to the results of their investigations being available for non-members Direct opposition of industrial firms to a policy of publication can in fact place the Department in a delicate situation, and since the work of a number of the associations has a direct bearing on problems confronting the defence forces, it can easily happen that industry itself may be responsible for withholding complete publication of the results of such investigations

Under modern conditions, therefore, it is essential that the research activities which are partly or wholly endowed by the State should be planned and co-ordinated in relation to the needs of the State as an organic whole and not on sectional lines Any attempt to discriminate too rigidly between the needs of a particular department of State and industry is likely to involve us in acute difficulties if duplication of effort is not to result This is, of course, not to deny the essential principle that, for example, such departments of State as the Medical Research Council or the Department of Scientific and Industrial Research, should not directly support researches which are primarily of interest to the fighting services and the expense of which should be borne by their own vote

Sir Frederick Gowland Hopkins has pointed out that scientific men are now in real control of scientific policy in Great Britain, even when it deals with enterprises endowed by the State Accordingly, much undoubtedly does depend upon the sincerity and loyalty with which scientific workers discharge their trust Except with their connivance and responsibility, funds allocated for civil purposes cannot be used for the endowment of researches for the benefit of the fighting services which should properly be a charge on votes for the latter purpose On their integrity the community must rely for ensuring that the civil vote is used entirely for civil purposes, whether or not defence purposes are served at the same time

It has to be remembered that scientific workers in Government service can only enter a protest against policy by leaving the service A State department could not tolerate criticism or opposition from its own servants, and the responsibility for determining what constitutes honourable conduct in regard to specific duties lies with the profession as a whole Accordingly, a healthy position and loyalty to the highest ideals are ensured as much by a widespread public spirit on the part of scientific workers generally as by the conscientiousness of individual workers The existence of such a public spirit would not only afford full professional support to those members in actual Government service in the unlikely event of need, but also would induce scientific workers to take an active part in educating public opinion as to the true functions of research in the modern State

Obtrusive Legislation

THOSE who have reason to know that infertility has an economic value, and that deliberate family limitation has been a factor of some importance contributing to their own social elevation, and wish to share with others the information and the practices which have been helpful to themselves, who hold the view that sex is not to be justified solely because of its relation to reproduction, and who think that parentage should be deliberate and voluntary and not casual and accidental, must necessarily wish to examine with the utmost care any proposed legislative measure which deals with the subject of contraception

At the present time, a Bill, presented by the Lord Dawson of Penn, and entitled "An Act to Restrict the Sale, Display and Advertisement of Contraceptives", is before the House of Lords and comes up for its second reading almost immediately A superficial examination of this Bill would yield the conclusion that no serious objection could be taken to its terms Its purpose is to make it illegal (1) to sell or offer for sale in any street or public place, or by means of an automatic machine so placed that it can be used by persons in any street or public place, any contraceptive, (2) to go to the premises of any person and there sell or offer for sale any contraceptive, unless the sale or offer is made in pursuance of a previous request of that person, or the premises are used by a dealer in contraceptives who buys to sell again, (3) to display in or outside any shop so as to be visible to persons outside the shop any contraceptive, or any picture or written description of any contraceptive; (4) to send or deliver, or cause to be sent or delivered, to any unmarried person who has not attained the age of eighteen years any circular or other document containing information of any kind whatsoever relating to any contraceptive

From the fact that the Bill is sponsored by Lord Dawson, who has long been an advocate of birth control, and several years ago, at the Church Congress at Birmingham, stated publicly that he was in favour of contraception, it may be assumed that the Bill is intended only to shield inexperienced youth from the stimulus of the pornographic, it certainly would make it impossible for such to indulge in sexual intimacy completely freed from its more grievous repercussions To rid the streets of touts and hawkers, and to force a certain kind of shop to adopt a different form of window-dressing is a truly commendable ambition, and if the sole effect of the Bill could be that those people who should use contraceptives would, in the future, obtain them easily from reliable and responsible sources, no one could cavil at it No one would, if it were the case that birth control clinics were an integral part of the municipal and State medical services, as they might be. But, can one be sure that the difficulties this Bill creates in the matter of obtaining contraceptives will really affect the incidence of promiscuity? May it not be that its main effect will be an increase in illegitimacy and in venereal disease?

The obtrusive display of contraceptives may be objectionable, but from the point of view of the State it is nothing like so wicked as bringing unwanted children into the world It may be assumed that in the immediate future, at any rate, the Bill, becoming law, would certainly tend to reduce the purchase of, and therefore the use of, contraceptives, not only by unmarried youths but also by those who, in the interests of themselves and of society, should use them for the limitation of their own families. The very ugliness and the vulgarity of the shop window can possess an educational value, revealing to the ignorant necessitous the fact that contraceptives exist In the opinion of many, this Bill, in the light of modern scientific thought upon the subject of birth control, must appear to be somewhat reactionary and deplorable; it interferes with the liberty of the individual, it hits others besides those at whom it is aimed, and it must interfere with the democratisation of contraception—one of the most socially valuable of all biological inventions. The further history of this Bill will show whether or not there is in the present Parliament anyone who can claim the privilege of wearing the mantle of Bradlaugh

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Position of British Broadcasting

The B.B.C. Year-Book, 1934. Pp 480 (London: British Broadcasting Company, 1934.) 2*s*

THERE is much of interest in this year-book We learn that for every fee of 10*s*. paid by a listener for his licence the Government takes 5*s* 5*d* and the B B C gets 4*s* 7*d* By issuing publications helping broadcasting, the B B C manages to increase this sum to 5*s* 10*d* per licence. A considerable amount of the energy of the management, therefore, must be spent in helping forward their publishing business It seems a pity that the B B C. has no capital resources and that all capital expenditure must be provided out of income Considering its national importance, it is not good policy that it should be cramped in this way

It would be interesting to know the reason why Hertfordshire is the county of England which has the greatest number (20) of licences for every 100 inhabitants. It is easier to see why Oxfordshire, Cambridgeshire and Surrey come second with 17. On p. 89 we are told that some 4,000 schools take broadcasting lessons, 80 per cent being elementary Obsolescence of sets, reorganisation and transfer of teachers are given as causes why some of these lessons have been discontinued. There can be little doubt that the difficulty experienced in obtaining a trustworthy standard set for reception has greatly hindered progress. We are glad that the Council of the B.B C and the Department of Scientific and Industrial Research have prepared a list of sets on the market suitable for school use. Negotiations are also being made with the Radio Manufacturers' Association regarding the development of a hire service and maintenance system. We are sure that if these facilities were available more schools would employ the new medium.

Parts of the technical section of the year-book are of special interest to the electrician. There is an excellent chapter on the calculation and measurement of field strength. Not only are the best practical formulæ given but their limitations are also pointed out. The usual formulæ postulate that the electrical conductivity of the earth is homogeneous throughout its mass. They also neglect the existence of hills and buildings. The proper corrections to be applied to the formulæ can only be learnt by experience. The would-be calculator need not, therefore, be disappointed if the measured values differ very appreciably from those calculated

We were disappointed to find that little reference is made to the scientific and engineering research work being carried out by the B B C The science of broadcasting is an outcome of applied physics, and judging by the rapid progress made in similar applications where research laboratories are considered necessities, scientific workers would like assurance on this point. The B B C must know, as well as the manufacturer, the more urgent problems that have to be solved, and it has many facilities for experimenting which are not available to the industry Continuous scientific and mathematical research is necessary if the B B C stations are always to be in the front rank In the next edition we should like to see the names of the engineers and scientific investigators employed by the B B C. and an account of the researches they have made and the progress achieved during the year

The Institution of Electrical Engineers has formed a committee to combat electrical interference with broadcast reception. It is composed of representatives of all the many interests concerned, including the B B C and the Post Office engineers. Various subcommittees have been formed to examine the problem and see how it can be remedied The disturbances that arise due to various classes of interference-causing apparatus are specially considered

We were glad to read about the short-wave work carried out last year both on the transmitting and on the receiving side. Particular attention was paid to the relative effectiveness of the many forms of aerial which are available at present The closing down of 5 XX and 5 GB when the new Droitwich station is completed will provide accommodation and space suitable for research work. Experimental work has been carried out at the receiving post at Tatsfield in Surrey. A new receiver suitable for relaying programmes from distant short-wave stations has been developed.

Problems on acoustics were continuously studied during the past year. Every new building that has to be adapted for studio purposes gives rise to new problems which can only be solved by research One of the problems is how best to insulate a studio from the sound waves coming from the other studios and from street and other noises

We are glad to read that the B B C is affording help to further the progress of the art of television For some years past experimental work has been going on with 30-line television transmitted by the ordinary transmitters used by the B B C A new line of research—television of the high definition type—is now being undertaken This type cannot be transmitted on the ordinary wave-lengths owing to the width of the side-band which is necessary These experiments are being conducted on ultra-short wave-lengths by means of a special transmitter erected on the roof of Broadcasting House This transmitter is capable of transmitting side-bands of 500 kc /s (about 600 metres) on either side of the carrier wave No 16 Portland Place has now been prepared as a large television studio, with a suitable sound accompaniment A stage is provided for the actors and an auditorium for the visitors Everything is ready for television programmes to be transmitted from this studio

The breakdown record for all the B B C stations is quite satisfactory The breakdown time consists largely of the time necessary to replace valves in those cases where it is not possible to switch in a spare valve without closing down The whole breakdown time in 1933 is equivalent to an average of 57 minutes per annum per transmitter

British Dyes

The Synthetic Dyestuffs and the Intermediate Products from which they are Derived Being the seventh edition of "Cain and Thorpe" entirely rewritten and enlarged By Prof Jocelyn Field Thorpe and Dr Reginald Patrick Linstead Pp xv + 472 (London Charles Griffin and Co , Ltd , 1933) 30*s* net

DYESTUFFS are of interest from two aspects, that of science and that of economics—we had almost written politics The story of the attempts, now happily attended with complete success, to create a British dyestuffs industry during and subsequent to the War is an oft told one Whereas 90 per cent of the colours used in Great Britain came from Germany in 1913, it is possible to write twenty years later, in 1933, that 90 per cent of the production required for the home market is made in Great Britain

An Act of Parliament was passed in 1920 prohibiting the importation of dyes and intermediates, except under licence, for a period of ten years, and a machinery, in the form of a committee, was established for granting licences which comprised representatives of both users and makers, the former being in the majority In addition, a representative committee was set up under the Board of Trade to advise in regard to the development of the industry This machinery has worked well, largely owing to the goodwill shown by all parties

Since the expiry of the period contemplated in the Act, this has been renewed from year to year under the Expiring Laws Continuation Act, until in 1933 the whole question of dyes was referred to the new Import Duties Advisory Committee, which took evidence from all the interests concerned Its considered report advised the Government that protection of dyes on the existing lines should become part of the permanent legislation of Great Britain and a bill giving effect to this intention has recently been passed by Parliament The dyestuff legislation has been strongly opposed on political grounds ever since its inception this has had an adverse effect on the recovery of the industry, which in consequence has been faced at times with considerable uncertainty as to the future It is hoped that the final settlement of the matter will remove dyes once and for all from the arena of politics, and so give the industry full scope to develop as the result of its intensive research programme

The book before us, which prompted these comments, was first launched by Cain and Thorpe in 1905, the former having had practical experience in industry During the arduous days when we were trying to build up the industry in Great Britain and train chemists from other spheres in the intricacies of dyes, it played a part of definite utility, as witnessed by the rate at which the various editions were exhausted

The last few years have seen many changes in the relative importance of the various groups of dyes, so that it has become necessary entirely to rewrite the subject for this, the seventh, edition, giving much more prominence to certain branches It is some years since Dr Cain passed away, Prof Thorpe has now the assistance of a younger colleague, Dr Linstead, who has already made a name as a research worker in this field

The book follows familiar lines; naturally it is largely structural formulæ, without which this branch of chemistry could not be intelligible—more than a word of praise is due to all concerned for the clear manner in which these are produced The three sections into which it is divided comprise the intermediates, the dyestuffs and a practical one giving precise directions for the preparation of a considerable number of substances

Criticism in detail of such a compendium is of interest only to the expert, it will be of more value perhaps to indicate the lines along which most progress is being made Outstanding is the general movement towards the production of faster dyestuffs, particularly the vat dyes of the anthraquinone series This has in part been made practicable by the greater availability of anthraquinone itself, prepared from naphthalene by the very striking modern aero-oxidation method The story would be incomplete also without mention of the discovery of 'caledon jade green', the best green vat dyestuff The second line of development has been the production of dyestuffs suitable for viscose and acetate silks, which has been attended with a success obvious to all of us Mention may be made of the 'ingrain' colours produced from the coupling components direct on the fibre, of the self-mordanting 'neolan colours' and of the 'indigosol' solubilised leuco esters

The main facts of the dyestuffs story have been driven home to the nation—research and always more research, research which makes us prepared for war and strong in peace, always finding new wonders of applied organic chemistry Nature is full of colours, as James Joyce writes, "they glow and fade, hue after hue, sunrise gold, the russet and green of apple orchards, azure of waves". yet man has been able to surpass them in brilliancy if not in beauty with his synthetic dyes

The work will take its place on our shelves as the standard textbook on its subject E F A

Structure and Development of Man

Human Embryology and Morphology. By Sir Arthur Keith. Fifth edition Pp viii + 558 (London Edward Arnold and Co, 1933) 32*s*. 6*d*. net.

THIS, the fifth edition of Sir Arthur Keith's textbook, will be heartily welcomed, as it has occupied for many years a somewhat unique position It embodies various distinct improvements over the fourth edition which appeared in 1923, but in spite of the accumulation of new facts and new points of view since that date, the author is to be congratulated on having been able to preserve the volume from undue expansion His clear and popular style of exposition conveys to the readers whom he has in view—students of medicine—the end results of the work of embryologists better than perhaps any other textbook The text is reduced to the minimum consistent with clarity Much detail has necessarily been omitted, but the needs of the medical student have been in this respect kept in view Although ideas differ regarding the relative importance of facts of observation and interpretation, Sir Arthur Keith's selection, in view of his long and varied experience, may be accepted, at least so far as organogenesis is concerned, as satisfactory

The old title of 1901 is perhaps rather out of date Descriptive embryology has now become largely merged in a new and more comprehensive morphology, and in this connexion the author's introduction of a new chapter on "Experimental Embryology" is to be commended The text of the old description has not been greatly altered, but it is fully brought up to date, and the addition to each chapter of a bibliographical appendix—coupled with notes—constitutes a valuable improvement The notes provide material for a different class of reader from the elementary text Many deal with more abstruse and doubtful points, and open vistas regarding the most recent advances, while the references to literature send the inquiring student to the sources where he will find—what the keener senior student desires—some knowledge of the actual evidence in sections and reconstructions from which the story has been compiled, and upon which the purely diagrammatic illustrations are founded These last have not been greatly added to, but we welcome some newcomers which show the same ingenious and informing quality as the old

The chapters on organogeny maintain the old level of clear elementary description which has given this textbook the success it has attained The section on the early stages of development is perhaps scarcely so successful It is relatively more popular and introductory This is inevitable without the use of more comparative data critically considered, but as a brief introduction it may serve sufficiently well the aim of the book as a whole. T. H. B

Short Reviews

Thermodynamics Applied to Heat Engines: a Textbook covering the Syllabuses of the B.Sc. (Eng.) and A.M.I.Mech.E. Examinations in this Subject. By E. H. Lewitt. (Engineering Degree Series.) Pp. x+347. (London: Sir Isaac Pitman and Sons, Ltd., 1933.) 12s. 6d. net.

A very useful account is given in this book, from an engineering point of view, of the application of thermodynamics to the theory of the steam engine, mechanical refrigeration, steam nozzles, steam turbines, fuels and the internal combustion engine. Students reading for the final examination for an engineering degree should find the accounts of these applications helpful. The author states that the "subject has been methodically developed from the fundamental laws of experimental physics". His attitude towards some of these fundamentals may be gauged from the quotations following, which the reviewer gives without comment.

"It has been calculated that a gas will occupy no volume at a certain low temperature known as absolute zero temperature . . . The accuracy of the assumption . . . is extremely doubtful, as the gas would liquefy . . . before this low temperature is reached."

"A perfect gas is the name given to the natural state of any substance of which the evaporation from the liquid state is complete."

"Liquids and solids have one specific heat only; but a gas is regarded as having two distinct specific heats . . ."

"Boyle found experimentally that when a gas is heated at a constant temperature the pressure multiplied by the volume remains constant."

"Entropy cannot be regarded as a physical property of the fluid; it is an imaginary property which was devised by Rankine and is used by engineers as a means of providing a quick solution for problems dealing with the adiabatic expansion of vapours." A. F.

Experimental Electrical Engineering and Manual for Electrical Testing for Engineers and for Students in Engineering Laboratories. Vol. 1. By Prof. V. Karapetoff. Revised by Prof. Boyd C. Dennison. Fourth edition, completely revised and reset. Pp. xxviii+781. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 37s. 6d. net.

This volume is written for engineers and for students in engineering laboratories. It contains very few mathematical formulæ and very little theory. It will be useful to electricians in testing laboratories and to students who have a wide elementary theoretical knowledge of the subject. As a work of reference it will be of value; the methods of testing given are good and many of them are standard methods in the United States. The methods given of diagnosing the causes of faulty running in machinery can also be recommended. We notice that in this edition the chapters on telephone practice have been omitted and also the chapter on primary cells. The book therefore deals more exclusively with heavy engineering.

Direct and Alternating Currents: Theory and Machinery. By Prof. E. A. Loew. Pp. xiii+656. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1933.) 27s. net.

In this volume the author reviews the theory of the electric circuit and the operating principles of electric machinery. The applications of electricity are now so numerous that it is very difficult to decide what to describe and what to omit. That everything has to be included in one volume makes it necessary to pass lightly over much theory, and since the student will in his future practice come across many types of equipment some of which it is necessary to describe, there is practically no space for modern theory. Luckily the laws and principles necessary to understand the performance of everyday electrical machines are few in number. The author has made a happy selection and the book will be useful to the technical student.

Practical Acoustics for the Constructor. By C. W. Glover. Pp. xi+468+27 plates. (London: Chapman and Hall, Ltd., 1933.) 25s. net.

There is little excuse nowadays for a badly designed hall, church or theatre—badly designed, that is to say, from an acoustic point of view. The principles which govern acoustic design are very well understood, and the number of books dealing with architectural acoustics is legion. Mr. Glover's addition to the list may be recommended as a thoroughly practical volume, designed for the use of practising architects. The information given is very full and detailed, and the work forms a most useful book of reference. There is a remarkable bibliography appended to the volume. A. F.

The Great God Waste. By John Hodgson. Pp. viii+127. (Eggington, Beds.: John Hodgson, 1933.) n.p.

Arguments are more likely to prove weighty in the absence of exaggerated presentment, and may easily show fallacies in depending upon statistics. Issue may be joined with the remark, that taxation impoverishes one class to enrich another; and the glorification of leisure as the *dolce far non troppo*, in place of an honest day's work, as hitherto understood, is to be deplored. Mr. Hodgson has wandered up and down and to and fro, with the amazing resultant discovery, that the U.S.S.R. deserves praise at the expense of the rest of the world. The trend of events during the last few months serves to discount the value of much of Mr. Hodgson's text. P. L. M.

Heavy Hydrogen and Heavy Water

IN a lecture delivered before the New York Section of the American Chemical Society on December 8, Prof. H. C. Urey gave some further information as to the properties of the heavy hydrogen isotope of mass 2·01356, that of light hydrogen being 1·00778 (both on the $O^{16} = 16$ scale).

Attempts had been made to separate the hydrogen by fractional distillation of the liquid, calculation showing that the vapour pressures should be different, but the method was not successful because the low surface tension of liquid hydrogen makes it difficult to prevent its escape as mist in the fractionating column. A method depending on diffusion into flowing mercury vapour was no more effective. Some details of the actual method of separation, depending on electrolysis with water-cooled nickel electrodes in cells each containing 300 c.c. of potash solution in water from commercial cells enriched to 0·5–1 per cent of "deuterium oxide", are given. The current is 25 amp., and 30 cells are placed in series across 110 volts. Electrolysis is carried on until the volume is reduced to one third, when the residual electrolyte is removed, two thirds distilled from the potash, and combined with the undistilled liquid. Electrolysis to one third is again carried out, and beginning with the second stage, the hydrogen and oxygen gases are recombined to give a liquid containing 0·3–0·4 per cent of "deuterium oxide". The progress of the fractionation is followed by observation of the refractive index.

Investigations on the equilibrium

$$2H^2I \rightleftharpoons H^2_2 + I_2$$

gave results agreeing with calculations which show, for example, that the ratio of the equilibrium constants with light and heavy hydrogen should be 1·222 at 700° abs. The equilibrium constants for the reaction

$$H^1_2 + H^2_2 \rightleftharpoons 2H^1H^2$$

gave 3·28 (3·27), 3·73 (3·77) and 3·75 (3·82) at 298·1°, 671° and 741°, abs., the calculated values being in brackets[1]. Experiments by Crist and Dalin showed that no interaction between heavy hydrogen and the light hydrogen of water over which the gas was confined had occurred in a few weeks; the different result reported by Oliphant[2] may have been due to the presence of a catalyst.

Experiments by Rittenberg and Urey on the electrolytic separation of hydrogen isotopes pointed to a kinetic explanation of the phenomenon; unless the differences in electrode potentials are much greater than those indicated by calculations, it does not seem possible that the separation is due to this cause[3]. The physiological properties of heavy water are supposed to depend on possible differences in ionisation constant and in reaction velocities as compared with ordinary water.

A design of electrolytic cell for concentrating heavy water has been described by Harkins and Doede[4] but no details of performance are given. The specific rates of discharge of light and heavy hydrogen atoms on various metal cathodes have been measured by Topley and Eyring[5] and the results considered with reference to the theory of over-voltage: they are not inconsistent with the view that the separation is almost entirely due to the zero-point energy difference. The slow process at the cathode does not appear to be combination of atoms to molecules.

A method for determining the concentration of the heavy oxygen isotope O^{18} in water during treatment[6] depends on decomposing the heavy water with heated iron and combining the liberated hydrogen with ordinary oxygen from hot copper oxide and condensing the water (X) so formed. The iron oxide is then decomposed by heating in ordinary hydrogen and the water formed (Y) condensed. The water X was found to be identical with the initial heavy water, whereas Y was identical with ordinary water. Hence there is no appreciable concentration of O^{18} in the electrolytic process.

Several investigations of the properties of heavy water, in addition to those already reported in these columns[7], have been published. The solubilities of one or two salts in heavy water are distinctly lower than in ordinary distilled water[8]: 1 000 gm. of ordinary water dissolves 0·359 gm. of sodium chloride at 25° and 1 gm. of water containing 92 per cent of hydrogen as H^2 dissolves 0·305 gm., a difference of 15 per cent, whilst the corresponding figures for barium chloride show a difference of 19 per cent.

The densities, refractive indices (n^d_{20} and n^c_{20}), molar refraction for D line, viscosity (η), surface tension (γ), dielectric constant (D), magnetic susceptibility (χ) and molar susceptibility of water containing 31, 63·5 and 92 per cent hydrogen as H^2 (assuming the density 1·1056 for pure H^2_2O) have been measured, and the values extrapolated to pure H^2_2O. Selwood and Frost's values[9] are (the values for ordinary water in brackets): n^d_{20}, 1·3281 (1·3329); n^c_{20}, 1·3265 (1·3309); η_{20}, 14·2 mp (10·87 mp); γ, 67·8 (72·75); $\chi \times 10^6$/gm. (92 per cent water), $-$0·65 ($-$0·72); molar susceptibility $\times 10^6$, $-$13 ($-$13).

Lewis and Macdonald found the viscosity at several temperatures (5°–35°) higher than that of ordinary water, but their value at 20°, 12·60, is not in agreement with Selwood and Frost's. The dielectric constant is lower than that of ordinary water: $D^2/D^1 = 0·982$ at 10°, 0·990 at 25°. The abnormality as compared with ordinary water decreases with rise in temperature for all properties investigated.

The refractive index[10] affords a convenient method of determining the proportions of H^2_2O

and $H^1_2O^{18}$ the effect of the O^{18} isotope is opposite in sign from that of H^2, and the measurement of the density and refractivity gives the complete isotopic composition (H^1, H^2, O^{16}, O^{18}) of a sample of water The mutarotation of *α-d*-glucose in heavy water shows that the displaceable hydrogen atom of the sugar is immediately replaced by H^2 from the water, and the mutarotation is due to a change in which the double bond in a carbonyl group, – C=O, is replaced by a ring formed by the migration of a hydrogen atom[11]

By the interaction of heavy water with magnesium nitride, ammonias in which the hydrogen atoms are predominatingly H^2 (deutero-ammonias) are produced, which have higher melting points, boiling points and latent heats than ordinary ammonia[12]

Further experiments on the physiological effects of heavy water[13] show that the filaments of *Spirogyra* in water of specific gravity 1 000061 are characterised by lack of movement, absence of abscission or cell disjunction, and greater longevity The usual effect with ice and steam water was confirmed[14] The results suggest a stabilising action of water containing H^2, perhaps an effect on the colloids in the organism, the water bound in such colloids being known to be denser than free water A slightly higher *p*H (as determined with bromthymol blue) for this sample of water was found. In other experiments[15], decreased enzyme activity and fermentation in isotope water, a more extensive spread of *Oscillatoria* (perhaps due to a *p*H of 6 77 as determined by the glass electrode), and the following results with *Spirogyra nitida* were found · a representative filament of 31 cells in isotope water had 43 cells after 6 days, of which 3 were dead , a filament of 37 cells in ordinary water showed no cell division at the end of 6 days and 20 cells died , in ice water renewed twice daily, a filament of 50 cells showed 15 abnormal at the end of five days, whilst the filament in freshly condensed water renewed twice daily showed all its 50 cells dead or shrunken in the same period , the control filament (pond water) had 47 cells initially and 64 normal cells after six days

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[1] Cf A and L Farkas, NATURE, **132**, 894, Dec 9 1933

[2] NATURE, **132**, 675, Oct 28, 1933 , cf Polanyi and Horiuti, *ibid* , 819, Nov 25

[3] cf Collie, NATURE, **132**, 568, Oct 7, 1933

[4] *J Amer Chem Soc* , **55**, 4330 , 1933

[5] *J Amer Chem Soc* , **55**, 5058 , 1933

[6] Selwood and Frost, *J Amer Chem Soc* , **55**, 4335 , 1933 NATURE, **132**, 536, Oct 7, 1933

[7] Taylor, Caley and Eyring, *J Amer Chem Soc* , **55**, 4334 , 1933

[8] Selwood and Frost, *J Amer Chem Soc* **55**, 4335 , 1933 Lewis and Macdonald, *ibid* , 4730 Lewis, Olson and Maroney, *ibid* , 4731 , Lewis and Luten, *ibid* , 5062

[10] Crist, Murphy and Urey, *J Amer Chem Soc* , **55**, 5060 , 1933 Lewis and Luten, *ibid* , 5061

[11] Pascu, *J Amer Chem Soc* , **55**, 5056 , 1933

[12] Taylor and Jungers, *J Amer Chem Soc* , **55**, 5057 , 1933

[13] Barnes, *J Amer Chem Soc* , **55**, 4332 , 1933

[14] NATURE, **132**, 536 Oct 7, 1933

[15] Barnes and Larson, *J Amer Chem Soc* , **55**, 5059 , 1933

Ernst Haeckel (1834-1914)

By PROF. E W MACBRIDE, F R S

THE career of Prof Ernst Heinrich Haeckel, the centenary of whose birth falls on February 16, belongs to the heroic stage of the history of the theory of evolution In 1862, at the early age of twenty-eight, he was appointed to the chair of zoology in the University of Jena, a post which he held until his death in 1914

Haeckel's life bears a strong resemblance to that of Huxley, for like Huxley his life's task was propaganda in favour of the theory of evolution against the then prevalent theory of the origin of species by a series of supernatural interpositions of the Divine Being Like Huxley too, he was an ardent advocate of the animal origin of the human race But there were marked differences between the two men , Haeckel was a harder hitter than Huxley, and withal a much more reckless one, since he was apt to make wild statements on the basis of insufficient data, as, for example, when he stated that if there were a line to be drawn between animals and men, the lower races must be included amongst the apes The most recent anthropological studies seem to indicate that in the essential make-up of their minds the most primitive men are very like ourselves · the data and presuppositions from which they start are different and so are their customs and traditions, but granted these postulates the conclusions at which they arrive are natural enough But on the whole, Haeckel was a sounder biologist than Huxley whilst he embraced with enthusiasm Darwin's arguments about natural selection, he was never deceived into thinking that the mere survival of some and the death of others could account for progressive evolution he saw quite clearly that the vital question was the origin of the 'variations' which distinguished the survivor from his less fortunate brother, and in this matter he followed Lamarck When he popularised his views in his famous "History of Creation" he dedicated the work to "Jean Lamarck and Charles Darwin"

Haeckel excelled Huxley also in the amount of actual zoological work which he accomplished Thus he wrote a descriptive monograph of the Radiolaria collected by H M S *Challenger*, giving the characters of no less than 3,600 new species This work occupied him for ten years He also monographed the calcareous sponges, but the greatest task which he attempted was to sketch, assuming the truth of the evolution theory, the actual course which evolution had pursued in producing modern plants and animals His conclusions were embodied in his "Allgemeine Morphologie", of which the "History of Creation" may be regarded as a popular edition Of course, the state of zoological and botanical knowledge at the time that these books were written was far too incomplete to permit of any but the vaguest sketches of the course of evolution, but there can be nothing but admiration for Haeckel's bold adventure. In the circumstances, it was the right course to pursue it summarised pre-existing knowledge and provided both a foundation and a framework for future work, and some of the most important and fundamental of Haeckel's ideas have stood the test of time Thus he divided living beings into Animals, Plants and Protista , regarding the last group, which included the simple unicellular organisms, as the common seed-bed from which both animals and plants have sprung The discovery of green ciliates like some species of *Stentor* and *Vorticella*, and of colourless carnivorous Dinoflagellates which devour young oysters, in addition to the ordinary brown species which live like brown seaweeds, has more than justified Haeckel's classification

Haeckel's most far-reaching hypothesis was, however, his famous 'biogenetic law' He invented the terms phylogeny and ontogeny—the first, according to him, designated the palæontological history of the race, the second the history of the development of the individual from the egg to the adult condition The law connecting these two was the 'Biogenetic fundamental principle' stated in his own words, it ran thus "Ontogeny is a short and quick repetition, or recapitulation of Phylogeny determined by the laws of inheritance and adaptation" Haeckel pointed out that if this principle be admitted, there is some hope of tracing, in outline at least, the actual course of evolution , whereas if we were to confine ourselves to palæontological evidence, we should only see glimpses of evolution in special cases The past history of the Vertebrata may be traced from fossils with considerable exactitude since vertebrates possess an internal skeleton which is often preserved and which gives in its scars and processes, evidence of the muscles which once accompanied it and consequently of the actions and habits of the animal which possessed the skeleton The external skeleton of extinct Crustacea which clings tightly to every protuberance of the body, also reveals a good deal about the activities of its former possessor But what scanty light do the shells of extinct Mollusca and the tests of ancient Echinoderms throw on the internal structure of their owners ! Who would dream from their evidence that radiate Echinoderms were derived from bilateral ancestors ?

In our judgment the formulation of this biogenetic law was the greatest service which Haeckel did to the science of zoology, and the more we reflect on it the greater the service will appear Haeckel was, of course, aware that these reminiscences of ancestral life could be modified, blurred or occasionally completely obscured He knew that for the elucidation of life-histories only the comparative method would avail , and just as in the comparison of two ancient documents the truth will shine through the errors peculiar to each one, so with life-histories

The acceptance of this law as giving a picture of evolution drew with it certain conclusions as to the causes of evolution. Haeckel described variations as 'adaptations' There were, he said, two classes of these, namely, (1) small ones which were the result of habits and which were *transmitted to posterity with greater certainty the longer they had lasted* (this is pure Lamarckian doctrine), and (2) great adaptations which appeared suddenly and the causes of which were unknown to us, though in some cases they appeared to have originated with intra-uterine influences These latter are now, of course, called mutations, and it was the first category alone which Haeckel believed to be significant for evolution, for the growth of the individual suggests that evolutionary growth was slow, functional and continuous

The biogenetic law proved a tremendous stimulus to zoological research Of course, it encountered opposition , its enthusiastic votaries desired, like all enthusiasts, to reach the 'promised land' at once they failed to realise that ancestral history could only be elucidated by prolonged, careful and comparative research They could not deny themselves the pleasure of making wild guesses as to ancestry based on the study of some one life-history and in time 'Haeckelismus' became a term of reproach But the principle was essentially sound , from all opposition it emerged triumphant it has been transferred to ever wider fields and has been found to throw light even on the development of the mental life of man A certain school of biologists at the present day affects to denigrate it and that for obvious reasons, for if it is sound then one thing is certain, mutations have played no part in evolution But ancestral history stands out so clearly in some life-histories that none but the wilfully blind can deny its presence Amongst the Ctenophora, for example, there are two aberrant forms, *Tjafiella* and *Cœloplana* The first resembles a sponge, the second a flat-worm , yet both begin their free existence as typical little Ctenophores, globular in form with 8 meridional bands of cilia radiating from the upper pole But if ancestral history is the foundation of some life-histories is it not reasonable to assume that it lies at the base of all ?

The real originator of the theory that evolution proceeded by jumps and that "Discontinuity in variation was the cause of discontinuity in species" was the late Dr Bateson In his first and best work on the development of *Balanoglossus* he found himself driven to the conclusion that Echinoderms and Vertebrates had radiated from a common stock and his faith in 'recapitulation' failed him, although it is interesting to record that this conclusion has been sustained by recent research and that from the most unlikely quarter, namely, biochemistry He then made "*il gran rifiuto*" and fell back on sports and monstrosities as the material of evolution. At the meeting of the Zoological Congress in Cambridge in 1898, Bateson put forward his views Haeckel was present at the meeting and some sentences of his still linger in our memory. He said that if views like these are to be accepted, "Kehren wir lieber zu Moses zuruck"

Prehistoric and Primitive Surgery

THE Vicary lecture before the Royal College of Surgeons was delivered on December 8 by Dr. L W G Malcolm, conservator of the Wellcome Historical Medical Museum, who chose as his subject "Prehistoric and Primitive Surgery"

The surgery of prehistoric and primitive times cannot be treated on rational lines when it is considered in time and space There is all the difference in the world between the ideas of primitive man and those of the founders of rational medicine and surgery—the Greeks. It does not appear that there is any community of ideas in the primitive world unless considered from the ritualistic point of view

Omitting for the most part reference to prehistoric Europe, to which detailed attention, especially in regard to trephining, has been paid by Dr. Wilson Parry, the available evidence shows that certain major operations have been performed by the prehistoric and primitive surgeons, involving a greater or less degree of skill and knowledge of anatomy, but such methods of treatment as bandaging, poulticing, lancing, bone-setting and the rarer amputation, massage, especially in relation to child-birth, cupping and bleeding, blistering and cauterising, fomentation and the vapour-bath were more or less common knowledge of the tribe, as the product of a real, if perhaps uncritical, experience

The leechcraft of the professional medicine-man, or shaman, is in a different category Although he has a knowledge of everything the lay medicine-man may practice, he is able to control the basis of magic, the universal power or soul-*mana*. Magical therapeutics may be traced from the earliest times down to the present day. The magical ritual had an accompanying expression in some therapeutic measure, for example, blood-letting or massage When a medicine-man, for example, trephined a head, he was performing a rite to satisfy the religious beliefs of the tribe, but as the tribe progressed in knowledge, the ritual process was abandoned and an allegorical object substituted as an offering to the god Thus a gourd with a hole in it was offered to the god, who accepted it as a trephined head in lieu of the actual operation.

Turning to the rational surgery of primitive and prehistoric peoples, trephining of the skull was practised by the pre-Columbian inhabitants of Peru, the methods employed falling into four groups: scraping, sawing, cutting, and drilling, the last being rare The objects of the operation were to treat a depressed fracture, such as might be caused by a sling-shot, to relieve pain or for superstitious reasons. The evidence on the whole does not support the use of a plate to fill the hole, or of suture. The operation is reported to-day, especially in North Africa, Polynesia, India and Peru

The lesion now known as the sincipital T is found on skulls from the dolmens near Nantes in France It takes the form of a long antero-posterior groove along the sagittal suture, terminating near the obelion where the transverse branch is encountered It has been recorded among the ancient Canary Islanders as due to the cauterising of a scarification with a flint knife, and a similar lesion has been found in a pre-Columbian female skull from Peru In the Middle Ages this operation was performed on demented individuals, usually female, to allow the application of heated objects to the skull It reduced "the amount of cold humours in the head".

The disease uta, a phase of leishmaniasis, has left traces on certain skulls from South America The primitive surgeon would appear to have amputated the diseased part of the face in one example The effects of this treatment are represented in the realistic Peruvian prehistoric pottery

In major surgical operations, the most astounding is the Cæsarian operation performed by a native of Uganda in 1879 The wound healed entirely on the eleventh day A similar operation has been recorded among the Chippeway Indians, but without detail. Ovariotomy is said to be performed in India and among the aborigines of Australia, but exact evidence is lacking. Although the Aztecs and Incas must have acquired a knowledge of anatomy from the practice of extracting the heart from the living sacrificial victim, they do not seem to have been led thereby to perform operations on the internal organs

Hernia was treated among the Pueblo Indians of America by the use of pads and bandages, and the Basket-makers used a flattish oval pad This was worn by new-born infants by means of long strings to prevent umbilical hernia Umbilical hernia is extremely common among primitive peoples, especially in Africa, but they do not appear to do anything for it

From the prehistoric pottery it would appear that the Incas performed some remarkable operations on the limbs. The cliff-dwellers of North America, who suffered severely from fractures, were skilled in the use of splints for thigh and arm, a purpose for which the Aztecs used the leaves of the century plant, moist clay serving as a cast. The aborigines of South Australia coat the fractured limb in a kind of plaster of Paris. Among the North American Indians, manipulation and particularly traction, manual and mechanical, were employed in the reduction of dislocations Relaxation was produced by the use of stramonium, alcohol, infusions of tobacco and other drinks.

Three methods of blood-letting are practised by primitive peoples: suction, scarification and venesection. Ingenious methods of venesection were employed. One found among the Indians of the Isthmus and Brazil was to shoot a stone-headed arrow into the vessel. This method is also found in New Guinea. Venesection is employed in the armpit, the forehead, the vertex and various other parts of the body. In Peru the veins at the root of the nose were opened The use of the cupping vessel is widespread.

The stopping of a blood-vessel presents difficulties, but the methods employed are amazing in their variety, including powdered gum, charcoal, ashes, eagle's down, bandages of bark, coconut fibre, etc A kind of tourniquet of bark cloth is recorded in Loyalty Islands, Tahiti, Samoa and Tonga The prevalent method of cleansing wounds among the American Indians was by sucking out the pus, a method which gave the shaman opportunity to display his magic power by showing a pebble which he had sucked from the wound

While it has been shown from the examples quoted above that the primitive peoples of America had a certain idea of rational surgical procedure, the remainder of the primitive world, with few exceptions, did not exhibit the same degree of surgical appreciation The races and tribes of Africa who practise an advanced procedure have derived their knowledge from other races—all tribes south of the Sahara, for example, have been influenced by Arabian surgery. There is, however, a remarkable number of mutilations which involve a certain knowledge of surgery. These are usually ritualistic in origin, such as circumcision (male and female) and infibulation There are no less than fourteen different methods of operating on the male genitalia employed in various parts of the primitive world. Among other forms of mutilation is amputation of the fingers, which was practised by the Aurignacian peoples of palæolithic times and is recorded by imprints on rocks in California, Arizona, Peru, Africa and Australia. Cicatrisation is also a sacrament Other mutilations in a variety of forms are practised on the nose and cheeks Piercing the tongue is not common, but excision of the tongue is practised in West Africa

A review of the subject leads to the belief that the resistance of primitive people is abnormal, compared with that of modern civilised races Their apparent indifference to pain and the infrequency of blood-poisoning indicate that modern races pay for their civilisation in terms of lessened resistance, pathology and neurology

The lecturer expressed his acknowledgments to Dr R Moodie and Dr L Freeman

Artificial Production of a New Kind of Radio-Element

By F JOLIOT and I CURIE, Institut du Radium, Paris

SOME months ago we discovered that certain light elements emit positrons under the action of α-particles[1] Our latest experiments have shown a very striking fact. when an aluminium foil is irradiated on a polonium preparation, the emission of positrons does not cease immediately, when the active preparation is removed The foil remains radioactive and the emission of radiation decays exponentially as for an ordinary radio-element We observed the same phenomenon with boron and magnesium[2] The half life period of the activity is 14 min for boron, 2 min 30 sec for magnesium, 3 min. 15 sec for aluminium

We have observed no similar effect with hydrogen, lithium, beryllium, carbon, nitrogen, oxygen, fluorine, sodium, silicon, or phosphorus Perhaps in some cases the life period is too short for easy observation

The transmutation of beryllium, magnesium, and aluminium α-particles has given birth to new radio-elements emitting positrons These radio-elements may be regarded as a known nucleus formed in a particular state of excitation; but it is much more probable that they are unknown isotopes which are always unstable.

For example, we propose for boron the following nuclear reaction:

$$ {}_5B^{10} + {}_2He^4 = {}_7N^{13} + {}_0n^1 $$

${}_7N^{13}$ being the radioactive nucleus that disintegrates with emission of positrons, giving a stable nucleus ${}_6C^{13}$. In the case of aluminium and magnesium, the radioactive nuclei would be ${}_{15}P^{30}$ and ${}_{14}Si^{27}$ respectively

The positrons of aluminium seem to form a continuous spectrum similar to the β-ray spectrum. The maximum energy is about 3×10^6 e v As in the case of the continuous spectrum of β-rays, it will be perhaps necessary to admit the simultaneous emission of a neutrino (or of an antineutrino of Louis de Broglie) in order to satisfy the principle of the conservation of energy and of the conservation of the spin in the transmutation.

The transmutations that give birth to the new radio-elements are produced in the proportion of 10^{-7} or 10^{-6} of the number of α-particles, as for other transmutations With a strong polonium preparation of 100 millicuries, one gets only about 100,000 atoms of the radioactive elements Yet it is possible to determine their chemical properties, detecting their radiation with a counter or an ionisation chamber. Of course, the chemical reactions must be completed in a few minutes, before the activity has disappeared.

We have irradiated the compound boron nitride (BN) By heating boron nitride with caustic soda, gaseous ammonia is produced The activity separates from the boron and is carried away with the ammonia. This agrees very well with the hypothesis that the radioactive nucleus is in this case an isotope of nitrogen.

When irradiated aluminium is dissolved in hydrochloric acid, the activity is carried away with the hydrogen in the gaseous state, and can be collected in a tube The chemical reaction must be the formation of phosphine (PH_3) or silicon hydride (SiH_4) The precipitation of the activity with zirconium phosphate in acid solution seems to indicate that the radio-element is an isotope of phosphorus

These experiments give the first chemical proof of artificial transmutation, and also the proof of the capture of the α-particle in these reactions[3]

We propose for the new radio-elements formed by transmutation of boron, magnesium and aluminium, the names *radionitrogen*, *radiosilicon*, *radiophosphorus*

These elements and similar ones may possibly be formed in different nuclear reactions with other bombarding particles protons, deutrons, neutrons For example, ${}_7N^{13}$ could perhaps be formed by the capture of a deutron in ${}_6C^{12}$, followed by the emission of a neutron

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[1] Irène Curie and F Joliot, *J Phys et Rad*, 4, 494, 1933

[2] Irène Curie and F Joliot, *C R*, 198, 1934

[3] Irène Curie et F Joliot, *C R*, meeting of Feb 29, 1934

Obituary

SIR DONALD MACALISTER, BART, K C B

BY the death at Cambridge on January 15 of Sir Donald MacAlister of Tarbert, in his seventy-ninth year, a great personality has passed out of the academic and medical life of Great Britain He was a Scottish highlander descended from the MacAlisters of Tarbert in Argyllshire, a family which for about five centuries possessed considerable lands in Kintyre and the heads of which were hereditary keepers of Tarbert Castle. Although originally a branch of the great clan MacDonald, they held their Tarbert possessions in charter from the Campbells with whom they cast in their lot in politics and war

Sir Donald MacAlister was born in Perth on May 17, 1854, and received his school education there and in Aberdeen and Liverpool, the changes in family residence being necessitated by his father's business activities In 1873 he entered St John's College, Cambridge, and in 1877 was senior wrangler and first Smith's prizeman in addition to receiving many other University distinctions A year later he was elected a fellow of his college and having meantime turned to the study of medicine he graduated M B in 1881 and M.D in 1884 Settling in Cambridge as a consulting physician, he was appointed Linacre lecturer on physic and a member of the staff of Addenbrooke's Hospital and thus became actively engaged in medical teaching His earliest professional studies had been in the domain of pathology, but this was soon superseded by pharmacology and therapeutics, subjects in which he retained a keen and active interest to the end. In recognition of his special attainments he was chosen president of the Section of Therapeutics at the Toronto meeting of the British Medical Association and for many years was chairman of the "British Pharmacopœia" Committee, the 1898 and 1914 editions of which owed a great deal to his collaboration

Although deeply interested in scientific and medical research and keenly appreciative of their results, Sir Donald MacAlister was never a 'research worker' in the ordinary sense of the term His cast of mind and abilities were more those of the statesman and administrator and it was in these directions that he found a congenial field for his activities and that he reached his highest distinction. In Cambridge he took a large share in the administrative work of the University and in 1889 was elected its representative on the General Medical Council He soon became one of its most influential members and when he resigned from it last year on account of failing health, he had served for forty-four years, twenty-seven of which were in the presidential chair As president his advice was frequently sought by the Privy Council and other Government departments concerned with the administration of medical education, pharmacy and the public health, and in these matters he gradually came to exercise a far-reaching influence

It was, however, not in medical matters only that Sir Donald MacAlister's influence on higher education and its administration was felt His exceptionally wide knowledge and culture rendered him highly sympathetic to all the many departments of university studies and activities, this led to his being chosen chairman of the Universities Bureau of the British Empire, chairman of the Commission on the University of Belfast, and to much other similar public work In 1907 he was appointed by the Crown to the high office of Principal of the University of Glasgow and shortly thereafter was made K C B In 1924 he was created a baronet in recognition of his many public services. When he went to Glasgow he had no special acquaintance with Scottish university affairs, but in a surprisingly short time he had acquired a complete grasp of them no less in their business than in their teaching aspects, and this soon found expression in numerous changes and reforms During his principalship he inspired such confidence in the citizens of Glasgow that money was freely forthcoming for the establishment of many new chairs and lectureships and for general university expansion. Nor were the social and athletic sides of student life overlooked A new Union costing £65,000 was built, new playing fields were provided and three residential halls for men and one for women were acquired by the University. From many contributors he received personally a large sum of money which was devoted to the building of a chapel in memory of those members of the University who perished in the War, and this will ever remain a beautiful memento of his principalship.

Besides being the recipient of honorary academic degrees too numerous to mention in detail, Sir Donald MacAlister was decorated by the French and Italian Governments, and from his fellow-citizens he received the freedom of the city of Glasgow in recognition of his great services to their University and in testimony of their personal esteem. In 1929 he resigned the principalship after twenty-two years service and was unanimously elected Chancellor of the University in succession to the late Earl of Rosebery and Midlothian His success as an administrator was largely due to an inborn aptitude for affairs, to a retentive memory for details and to a clear conception of the objects to be attained, but these were greatly enhanced by his industry, his devotion to duty and, as time went on, his wide experience

WE regret to announce the following deaths

Prof. H. L. Chablani, professor of economics in the University of Delhi, on January 14, aged forty-four years

Prof Fritz Haber, formerly director of the Kaiser Wilhelm Institute for Chemistry and professor of physical chemistry in the University of Berlin, known for his work on the thermodynamics of gas reactions, on February 1, aged sixty-five years.

Dr William Page, general editor of the "Victoria History of the Counties of England", and a commissioner of the Royal Commission on Historical Monuments (England), on February 3, aged seventy-two years

Capt J White, C B, R N, formerly dean of the Royal Naval College, Greenwich, previously professor of applied mechanics at the College, on January 28, aged sixty-three years.

News and Views

"Letters to the Editor"

DURING the year 1933, no less than four hundred communications appeared in NATURE under the heading of "Letters to the Editor", the big majority of which were the first announcements to be published of new work—news from the actual contributors to advances in science. Of this total, 201 were from scientific workers in universities and similar research centres in Great Britain and Ireland, and the remainder, 199, were from workers abroad distributed by continents as follows. Europe 78, America 57, Asia 37, Australia 14, Africa 13. In this week's issue of NATURE we are devoting 20 columns to 'letters' and the size of the journal has been increased to provide the necessary space. These 20 columns are, we believe, representative of the correspondence normally appearing in NATURE. The various items record current advances in biochemistry, atomic physics, radio communication, chemistry, biology and so on, and they are written by workers in Allahabad, Cambridge, Copenhagen, Dehra Dun (India), Groningen, Liverpool, London, Maine (U.S.A.), Nanking, Oxford, Schenectady, Stockholm, Sydney and Uppsala. Science truly is not confined by national boundaries. We think it a high compliment that scientific workers all over the world should regard our columns as the appropriate place to announce the progress of their labours and to discuss scientific matters and topics in which science and its methods are involved.

THIS part of the function of NATURE as an international journal of science has increased steadily in recent years. For some time past, the section of the journal devoted weekly to "Letters to the Editor" usually occupies 12 columns and frequently has been increased to 14 columns or more. Already this year we have printed 88 columns of 'correspondence', including the 20 columns appearing in this issue. Yet the waiting list is still large. The amount of space which can be given to 'letters' in a normal issue of NATURE must of necessity be limited if the journal is to discharge the remaining part of its function as a general journal of science, and we may even be obliged in the future to ask correspondents to limit their 'letters' to about five hundred words, or one column of space. For the present, we would urge them most strongly to be concise and precise in their communications, so far as is consistent with making them intelligible to the general reader A certain amount of specialised matter is inevitable in announcements and discussions, particularly of recent advances, but severely technical communications, of interest to a few workers only in the same highly specialised field, are out of place in a general journal such as NATURE, which endeavours to keep its readers informed of the broad lines of progress in all scientific subjects.

Dr. C. V. Drysdale, C.B., O.B.E.

DR C. V DRYSDALE, director of scientific research at the Admiralty, whose impending retirement is announced, has long been recognised as an authority on electrical measurements. In the early part of this century, while in charge of the Electrical Engineering Department of the Northampton Polytechnic Institute, he devoted considerable attention to measurements in the alternating current circuit, and his work on the dynamometer wattmeter, and particularly the development of the double element instrument for the measurement of polyphase power, is now well known. This was followed by several important contributions to technical literature on alternating current measurements, and included his pioneer work on the design of instrument transformers. The regenerative dynamometer together with the cone stroboscope were also devised at about this time for the equipment of the laboratories He also investigated the possibilities of using iron cores in dynamometer instruments and had some of the first iron-cored wattmeters built to his design which gave remarkably good performance. The simple phase shifting transformer was also designed and built, being originally intended to facilitate testing the performance of wattmeters at low power factors, and eventually this apparatus made possible his adaptation of the direct current potentiometer to the measurement of alternating potentials. This was the first self contained instrument for this purpose, and in connexion with it he designed the first vibration galvanometer with tuning effected by variation of the magnetic control. He also gave considerable attention to accurate resistance measurement and devised a new form of standardising bridge which was a combination of the Kelvin and Carey Foster principles, and allowed of precise comparisons between standards over a wide range of values to be made with great accuracy and rapidity, and in connexion with this bridge he developed a novel and accurate ohm standard ingeniously compensated for temperature change. Some time later he designed low resistance standards with very small time constants for use in alternating current circuits.

DR. DRYSDALE'S activities were not, however, entirely confined to work in electrical measurements, for at one time he gave considerable attention to the testing of magnetic materials and investigated the rotary hysteresis in iron and steel and developed an ingenious permeameter for testing magnetic materials in bulk. He also contributed papers on the radiation from black-bodies and made some important determinations of the mechanical equivalent of light which were communicated to the Royal Society. To him also belongs the credit of initiating the teaching of technical optics, in what is now the Technical Optics Department of the Northampton Polytechnic Institute, and into this work he carried the same enthusiasm and originality that characterised his electrical work. He devoted much attention to the curvature method of teaching optics and devised many original methods of optical testing and the apparatus for carrying them out. When the War came his services were placed at the disposal of the Admiralty in connexion with submarine detection and destruction, and here his sound theoretical knowledge and brilliant inventiveness found considerable scope and resulted in the appointment from which he is now retiring. Dr. Drysdale is also known as the president of the Malthusian League and as the author of numerous papers on eugenics.

Sir William Preece (1834-1913)

WILLIAM HENRY PREECE, the distinguished electrician, was born at Bryn Helen, Carnarvon, on February 15, 1834. Educated at King's College School and King's College, London, he came under the influence of Faraday at the Royal Institution and, deciding to become an electrician, in 1852 he entered the office of Edwin Clark. The following year he was appointed a junior engineer on the staff of the Electric and International Telegraph Co. and afterwards was telegraph engineer of the Channel Islands Telegraph Co. and the London and South-Western Railway Co., introducing many improvements in railway signalling. In 1870 he joined the staff of the Post Office, becoming in 1892 the engineer-in-chief, a position he held until 1899. His work in telephony began in 1877 and it was he who brought to England the Bell telephone with which Kelvin and Haughton gave an amusing demonstration at the Plymouth meeting of the British Association that year. As much scepticism existed regarding the capacity of the telephone, Preece arranged for the transmission of the notes of a bugle from Southampton to the Royal Institution during a lecture he delivered. A large and distinguished audience was present and at the appropriate moment Preece asked Tennyson to listen at the telephone. After doing so for a few moments, the poet remarked gruffly, "I hear nothing." Preece, catching up the telephone, after adopting a listening attitude, said, "I can hear, 'The Campbells are Coming' ", and then proceeded with his lecture, none in the audience realising that the bugler had mistaken the date, and that Preece himself, like Tennyson, had heard nothing.

PREECE'S work on telephony led him in 1885 to make experiments on induction signalling and in 1892 he sent messages across the Bristol Channel from Penarth to Flat Holme. His work in this direction came to an end, however, with the use of the Hertzian waves. "Strange to say," wrote Silvanus Thompson, "he entirely missed the significance of the wireless signalling by Hertzian waves shown by Lodge at the British Association meeting at Oxford in 1894, and yet when Signor Marconi arrived upon the scene in 1896 using the same method and the same devices of oscillators, spark gaps, coherers and tappers, Preece received him with open arms and put the resources of the Post Office at his disposal with results known to all the world." By the time Preece retired three years later, wireless messages were being sent across the English Channel and between some of H.M. ships. Preece, who was admitted F.R.S. in 1881, twice served as president of the Institution of Electrical Engineers and in 1898 was elected president of the Institution of Civil Engineers. He was knighted on his retirement and was afterwards consulting engineer to the Colonies. His death took place at Penrhos, Carnarvon, on November 6, 1913.

Russian Ascent into the Stratosphere

SYMPATHY will be felt for the three Russians, Fedoseenko, Vasenko and Usyskin, pilot, engineer and student respectively, who met their deaths on January 30 in an attempt to investigate further the phenomena of the upper atmosphere. It was announced in the Press that a new height record of about 70,000 ft. had been established for a manned balloon, a conclusion arrived at from the record of the damaged barograph. The pressure reached, however, has not yet been published. Apparently the accident was due to heavy weather as the prime cause, for it appears that the balloon travelled about 350 miles in a south-easterly direction from Moscow in the first four or five hours of its flight. Two of the occupants were unwell and in dropping rapidly through cloud, the collection of ice on the gondola, together with that falling on it from the lower part of the balloon structure itself, and other chafing actions, eventually parted the gondola from the balloon. The chief object of the flights, organised by the Society for Aviation and Chemical Warfare, was to investigate cosmic rays and it has been said that thirty instruments for various purposes were being carried The balloon expanded had a diameter of 115 ft and the whole weighed 2 tons The metal parts were of rustless steel The lowest pressure record of 50 mm (61,000 ft) for a balloon rests at present with the stratostat *U S S R* piloted by M Prokofiev last September

Photographs and Early Maps of the Fenland of East Anglia

IN the Art Gallery of Messrs W. Heffer and Sons, Ltd, Cambridge, there is an exhibition of ancient maps of the Fenland and of recent aerial photography of the same region. This exhibition, which will be open until February 12, directs attention to the activities of the organising body, the Fenland Research Committee, which was founded under the presidency of Prof A C Seward in 1932, for promoting the intensive investigation of the complex history of the Fenland basin The members represent the interests of archæological, botanical, geological and historical science, co-operating closely in attacking the very complex problems of the developmental history of the Fenland basin Co-ordinated excavations have already been made and a number of publications have appeared One extremely important side of the work of the Committee is the aerial photography of the entire region. This reveals on the silt area of the fens beside the Wash a hitherto unsuspected density of remains of the Romano British occupation and of later times Field systems, *dwellings, river-beds, droves and creeks are visible* in great profusion and clarity, and the examination, interpretation and mapping of these remains will be a major activity of the Committee for some time to come The preparation of suitable field maps for use in this task is a heavy charge on the Committee and the exhibition is intended to stimulate public assistance to the provision of part or all of the sum of £500 required

Beam Wireless Communication with China

ON February 3 a new Marconi beam wireless station was opened at Chenju, near Shanghai, to give direct radio communication with Great Britain, and it is anticipated that within the next year Shanghai will be in telephonic communication with London. This will add yet another link to the already widespread ramifications of the international radio telephone service available from London. In announcing the opening of the new station, the *Times* recalled the fact that the first wireless station in China was erected by that journal at Wei-hai-wei in 1904 in order to receive dispatches during the Russo-Japanese war from its correspondents on board a steamer specially chartered for the purpose. The Marconi Co later undertook the establishment of communication for the Chinese Government, and the recent extension referred to above is due to the enterprise of the Ministry of Communications The whole of the technical material used for the Chenju station was purchased in Great Britain with funds from the British Boxer indemnity, and Chinese engineers have co-operated most effectively in the installation.

Electric Discharge Lamps

SOME interesting characteristics of the new electric discharge lamps were described and demonstrated in a lecture given before the North-West Area Section of the Illuminating Engineering Society at Manchester on January 30 by Mr H. R. Ruff, of the Research Department of the British Thomson Houston Co, at Rugby. Mr. Ruff showed that highly coloured wall papers are completely robbed of their colour by a form of lamp using sodium vapour, appearing as though executed only in black, white and grey On the other hand, an electric discharge lamp using mercury vapour was shown to contain strong yellow, green and blue elements—with the result that coloured papers show up quite well by this light Numerous installations of these lamps are being made in streets throughout Great Britain, and they are also proving to have interesting possibilities for use in factories A certain amount of care is, however, necessary when applying them to processes with revolving machinery, owing to the formation of stroboscopic effects, by which wheels appear to be turning in a contrary direction These lamps provide about 16,000 lumens for a consumption of 400 watts and can be adapted to ordinary supply circuits using either alternating or direct currents, although the former is more convenient. The efficiency is 2½ 3 times that of a filament lamp A new form of vacuum lamp containing mercury which emits a moderate amount of ultra-violet light and is thus useful from the hygienic point of view was also shown

Constitution of the Upper Atmosphere

PRESENT conceptions of the physical and chemical constitution of the upper atmosphere were summarised in a most entertaining way by Dr G C Simpson in the twenty-fourth Bedson lecture delivered at Armstrong College, Newcastle-upon-Tyne, on February 2 Dr Simpson dealt first with the thickness of the troposphere over the earth's surface, and the temperature distribution within it, and throughout the stratosphere, including the discoveries of Lindemann and Dobson since 1920 from observations of meteors, also ozone concentration and distribution relative to (surface) atmospheric pressure. The evidence of sound wave and wireless wave reflections was then reviewed, and finally the evidence from auroral observations on the influence of sunlight, and on the composition of the atmosphere. Clouds in the stratosphere, and the dissociation of oxygen and nitrogen molecules at 100 km and above were all touched upon. Throughout his lecture, Dr. Simpson stressed the uncertainty of prophecy in these matters, but his exception of weather forecasting caused amusement Most of the learned societies of the district were represented in the audience, which was highly appreciative of the visit.

Neon Signs

THE discharge tubes used for advertising are a development of the old Geissler and Crookes tubes in which various beautiful effects were produced when evacuated tubes filled with certain gases were excited by an induction coil. In the January Engineering Supplement to the *Siemens Magazine*, there is an interesting article on the construction and the physical theory of commercial discharge tubes by E. A Beavis Forty years ago, the gases used were mostly nitrogen and carbon dioxide, and these required continual replenishing It was only when the rare gases, argon, neon, helium, etc , were experimented with that it was found possible to obtain a reasonably permanent luminous discharge These gases are not subject to absorption to anything like the same extent as the commoner gases Neon at a suitable pressure gives more visible light and has a lower electrical resistance than the other permanent gases and hence a greater length of tubing can be operated for a given voltage Neon has a cheerful red glow, argon gives a faint lavender colour and has little luminosity, and helium has a whitish glow Combinations of various gases and vapours with neon and the use of coloured glass tubes have enabled many striking and pleasing coloured effects to be obtained The positive column extending to the anode forms the main region of luminosity in the tube By mixing traces of impurity in the gas, it is possible to obtain narrow cords of light which move within the tube and give rise to the type of discharge known as the 'ripple neon' Sometimes also the column of light splits up into rows of coloured discs which often rotate round the axis of the tube These effects are known as 'striations' Alternating current is used for operating commercial tubes. As the voltage absorbed under running conditions is about 200 volts per foot of tube, it is usually divided up into a number of sections each supplied by a separate transformer

Banting Research Foundation, Toronto

THIS foundation arose out of the desire to commemorate the discovery of the active principle of the islets of the pancreas by Dr. F. G. Banting in 1921-22, and has received wide financial support in Canada. It has now been in active operation for six and a half years, though in the first two years the full capital sum was not available and the number of grants made were few. The capital sum now amounts to about 700,000 dollars and the number of individual grantees has steadily increased The total number of grants made during the period is 92. These have been distributed to 63 workers in the following universities: Alberta 4, Saskatchewan 2, Dalhousie 8, Queen's 2, Western Ontario 2, Manitoba 16, McGill 26, Toronto 30 and 2 non-university. Some fifty papers have already appeared in scientific publications, while a further fifteen are in press or ready for publication. Several pieces of work are not as yet complete. In accordance with its charter, the Foundation also aids in the support of the Department of Medical Research, University of Toronto (Dr. F. G Banting) and from this source numerous papers on silicosis, the action of vitamins and other topics have appeared During the past year twenty workers received grants from the fund. The Foundation, which is the only one in Canada giving support to medical research, has proved a valuable aid and stimulus to such research in that country The world economic depression has increased the demands upon the Foundation, the trustees of which would welcome a larger revenue. Correspondence should be addressed to the Banting Research Foundation, Toronto, Canada

Reptile Skins in Commerce

A FEW years ago the use of the skins of reptiles in the manufacture of shoes was regarded as a whim of the moment, but now the view is strongly held by the leather trade and by technical experts in the industry that the skins are established as a raw material for leather production on as permanent a basis as goat, calf and sheep skins This is the view expressed by the sub-committee appointed by the Imperial Institute Advisory Committee on Hides and Skins (*Bull Imp. Inst*, 31, No 2, 160, 1933) The change in outlook has taken place since 1926, when reptile skins were employed only in the making of luxury articles, now they are used for the mass-production types of shoes, as well as for bag and fancy leathers. Some of the advantages of reptile leather are that it is hard-wearing, stronger than sheep, goat or even calf skins, it shows great variety of pattern and design, and it takes colour readily But the demand has been telling upon reptile populations in various tropical countries In 1932, India exported 2½ million reptile skins, in 1931, more than two million came from the Dutch East Indies, and serious depletion has occurred in the stock of the North American alligator, the edible terrapins of the United States, and the green turtle, the last being valued as food An exhibition of reptile skins and their products will be opened at the Imperial Institute on February 12 at noon by Lieut.-Col J Colville, Parliamentary Secretary to the Department of Overseas Trade

Eton College Natural History Society

IT is encouraging to find that in the public schools of Great Britain there is no sign of declining interest in field studies. The expeditions held on holidays and half holidays by the Eton College Society are excellent as introductions to natural history, and may lead to the more individual interest which is revealed in the lists of records, of lectures, and of museum preparations mentioned in the annual report for 1932-33. The report is enlivened by photographs taken by the members, and a list of Lepidoptera from the Eton district, by Brigadier-General B. H. Cooke, should be useful as a check-list for youthful collectors.

Destructive Earthquakes in 1933

SCIENCE SERVICE, Washington, D.C. (Mail Report, December 28, 1933) has issued a list of 39 earthquakes in 1933 that were strong enough to be recorded by distant seismographs. Of these, only five caused the loss of many lives. The most destructive was the Sanriku (Japan) earthquake of March 3, by which 1,560 persons were killed in addition to 956 others missing. The Long Beach (California) earthquake of March 10 was responsible for the loss of about 120 lives, the Kos earthquake of April 23 for about 100, the West Sumatra earthquake of June 24 for about 70, and the Chinese earthquake of August 25 for about 100. The Baffin's Bay 'earthquake' of November 20 would no doubt have added to the number had it not occurred in an uninhabited region. The total number of persons killed by earthquakes in 1933 is thus less than 3,000, or less than one-half the number killed on the roads in Great Britain, and much less than the average number (about 14,000) killed by earthquakes every year (NATURE, 126, 214; 1930).

Early Students' Laboratories

WHEN Lord Kelvin opened the laboratories of University College, Bangor, in 1885, he gave an address on scientific laboratories which was printed in NATURE of March 5, 1885, p. 409. He stated that the physical laboratory he started in an old wine cellar in the University of Glasgow on his appointment as professor of natural philosophy in 1845 was the first one intended for students' practical work, and that the first chemical laboratory for a similar purpose was that of Prof. von Liebig at Giessen, founded "not many years after 1831". In the November issue of the *Review of Scientific Instruments*, Prof. P. C. Ricketts brings forward evidence that both physical and chemical laboratories for the regular use of students were provided at Rensselaer by Amos Eaton when he became professor of chemistry and experimental philosophy there in 1824, and that "the instruction was extremely systematic and continuous".

Microscopes and their Accessories

WE have received from Messrs. W. Watson and Sons, Ltd., 313 High Holborn, London, W.C.1, a copy of the new edition of their microscope catalogue. A number of microscope stands of varying complexity are listed, and ranging in price from £4 to £100, together with ranges of objectives, eye-pieces, sub-stage fittings, etc. Several pages are devoted to a description of the principles of construction adopted by Messrs. Watson. The limb, carrying the body at one end and the sub-stage at the other, is machined from a solid casting, ensuring basic alignment throughout, and that the stage bracket is truly at right-angles to the body and sub-stage. Similarly, the tube, rib and objective fitting are machined from a solid metal billet, instead of being in three pieces as formerly, so that the risk of separation of parts is abolished, and enduring parallelism between the mechanical and optical axes is ensured. Water immersion objectives, a new low-power binocular, and new dark-ground condensers also find a place in the catalogue.

Plan for Exploring Soviet Far North in 1934

AT a recent session of the Scientific Council of the All-Union Arctic Institute, plans were adopted for expeditions to the far north during this year. The plans include extensive exploration of the great northern sea route. The *Moscow Daily News* reports that particular attention is to be paid to the little-known Laptev and Eastern Siberian seas. Geological expeditions will aim at creating a fuel base for ships navigating the great northern sea route and at discovering ores of non-ferrous and rare metals. Their attention will therefore be concentrated on Novaya Zemlya, the eastern part of the Chukotsk peninsula and Northern Land, where indications of oil, coal and ores have been found. Geodetic expeditions with an aeroplane at their disposal will carry out preparatory work for compiling the first 1 : 1,000,000 map of the Soviet Arctic, to be published in 1937. Five new permanent research stations will be added to the existing twenty, and a new laboratory for the study of magnetic phenomena will be erected near the estuary of the Kolyma. Attention is to be paid to the study of reindeer and polar dog breeding. Special breeding farms are to be organised in order to facilitate communication between the stations along the northern sea route.

Pumps at the Science Museum

THE plan now being followed at the Science Museum, South Kensington, is to publish handbooks of two kinds, one containing historical notes, and the other containing details of the exhibits. Some time ago we directed attention to the new volume of "Historical Notes on Pumping Machinery" and we now have pleasure in referring to the new "Descriptive Catalogue". Like the former, this has been prepared by Mr. G. F. Westcott. The notes placed alongside the exhibits in the Science Museum have long been known for their fullness and their accuracy, and the "Descriptive Catalogue" contains more than five hundred of these notes together with many excellent illustrations. The pumping machinery collections are divided into about twenty groups and the exhibits range from the most primitive baling appliances to large turbo-blowers and the mercury vapour vacuum pumps of Gaede and Langmuir. The price of the new volume is 3*s*. 6*d*., so that for 6*s*. the reader can obtain both handbooks, which together contain more precise information on pumps of all kinds than can, we believe, be found in any other publication. The compiling of such catalogues involves a very great amount of research and Mr. Westcott is to be congratulated in having brought his task to a successful conclusion.

Medals of the Institution of Chemical Engineers

AT the twelfth annual corporate meeting of the Institution of Chemical Engineers on February 16, presentation will be made of the Moulton medal, the

Junior Moulton medal and prize of books, and the Osborne Reynolds medal, all of which were instituted in 1929. The Moulton medal, which commemorates the chemical engineering work of the late Lord Moulton at the Department of Explosives Supply, is awarded for the best paper of each year presented before the Institution. Papers by non-members of the Institution are eligible for this medal. For 1933 the award is made for the following papers: "The Mechanical Properties of some Austenitic Stainless Steels at Low Temperatures", by Messrs. E. W. Colbeck, W. E. MacGillivray and W. R. D. Manning; and "The Mechanical Properties of Metals at Low Temperatures (2)—Non-Ferrous Materials", by Messrs. E. W. Colbeck and W. E. MacGillivray. The Junior Moulton medal is given for the best paper of the year read before the Graduates and Students Section of the Institution. Only papers by graduates and students of the Institution are considered for this medal and prize. For 1933 the award is made for the paper: "The Solvent Extraction of Sulphur from Sicilian Ores", by Dr. E. H. T. Hoblyn. The Osborne Reynolds medal commemorates the fundamental investigations of the late Prof. Osborne Reynolds, and is awarded for meritorious service for the advancement of the Institution. For 1933 the award is made to Mr. H. W. Cremer. Mr. Cremer acted as honorary secretary of the Institution during the illness of the late Prof. J. W. Hinchley in 1931, and was appointed to succeed Prof. Hinchley in that office on the latter's death.

Announcements

H.R.H. THE PRINCE OF WALES has consented to become patron of the London School of Hygiene and Tropical Medicine, with which is incorporated the Ross Institute.

THE Catherine Wolfe Bruce gold medal of the Astronomical Society of the Pacific for the year 1934 has been awarded to Prof. Alfred Fowler, Yarrow research professor of the Royal Society and professor of astrophysics in the University of London (Imperial College of Science), for his distinguished service in the field of astronomy.

THE council of the Institution of Electrical Engineers has made the twelfth award of the Faraday medal to Sir Frank E. Smith, secretary of the Department of Scientific and Industrial Research. The Faraday medal is awarded either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution. Dr. R. Thury, of Geneva, has been elected an honorary member of the Institution.

MR. C. S. WRIGHT, superintendent of the Admiralty Research Laboratory at Teddington, has been appointed as from July 8 to be director of scientific research, Admiralty, in succession to Dr. C. V. Drysdale.

PROF. HANS FISCHER, professor of organic chemistry and *Privatdozent* in plant physiology in the Bavarian Technical High-school, Munich, will deliver the fourth Pedler lecture before the Chemical Society on Thursday, February 22, at 8 p.m., in the lecture theatre of the Royal Institution. The title of Prof. Fischer's lecture will be "Chlorophyll". Admission to the lecture will be free without ticket.

A CONFERENCE on "Problems of Potato Growing" will be held at the Rothamsted Experimental Station, on Tuesday, February 20, at 11.30 a.m. The chair will be taken by Capt. J. Mollett, chairman of the Potato Marketing Board. Papers on problems in potato cultivation will be read by Drs. G. H. Pethybridge, R. T. Leiper, H. E. Woodman, E. M. Crowther, and Mr. H. V. Garner. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden.

WITH the issue on January 5, the *Deutsche Medizinische Wochenschrift* entered the sixtieth year of its existence. It contains several important articles, notably one on rheumatic diseases by Prof. Aschoff, and another by Prof. Heine on inflammatory conditions of the iris, with an excellent coloured plate.

A VOLUME of "Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge during the Academical Year 1932–1933" (Cambridge University Press, 1933) has been issued, the summaries having been approved by the examiners or by the student's supervisor. By this means, the nature of research work which might otherwise be overlooked for a time is made easily accessible, and copies of the dissertations can be consulted if desired in the University Library or at the University Registry.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An agricultural chemist at the Imperial Institute of Agricultural Research, Pusa—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Feb. 12). A curator of the Wakefield Museum and Art Gallery—The Town Clerk, Town Hall, Wakefield (Feb. 17). A borough engineer to the Metropolitan Borough of Hackney—The Town Clerk, Town Hall, Hackney, E.8 (Feb. 17). An inspector in connexion with agricultural and horticultural education and research—The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, S.W.1 (Feb. 26). A temporary veterinary officer to the Lancashire County Council—The Clerk of the County Council, County Offices, Preston (Feb. 28). A bacteriologist and clinical pathologist at Queen's Hospital, Birmingham—The House Governor (March 5). A City bacteriologist to the City Council and professor of bacteriology in the University of Liverpool (joint appointment)—The Registrar, The University, Liverpool (April 14). An assistant in the Museum at the Royal Botanic Garden, Edinburgh—The Regius Keeper.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Mass Excretion of Œstrogenic Hormone in the Urine of the Stallion

IN earlier investigations[1] it was shown that the largest quantities of œstrogenic hormone (folliculin — s. œstrin) are excreted in the urine of pregnant mares (100,000 mouse units per litre). I found this also to be the case in other equines (ass, zebra) during pregnancy, whereas, in the non-pregnant state, the excretion of hormone both in equines and in other mammals is very small, at most 0.5 per cent in comparison with that of the gravid animal. Curiously enough, as a result of further investigations, it appears that in the urine of the stallion also, very large quantities of œstrogenic hormone are eliminated. (The first determinations indicating the high content of œstrogenic hormone in the urine of the stallion were made by Dr. E. P. Haussler in the scientific laboratory of Hoffmann-La-Roche in Basle.) According to my analyses, the amount of hormone varies between 10,000 and 400,000 m.u. per litre of urine, the differences appear to have some relation to the origin of the animals. 37 litres of urine obtained from four stallions were rendered acid to congo-red by the addition of mineral acid, boiled for five minutes and subjected to exhaustive extraction with benzol. In this way I found a hormonic content of 170,000 m.u. per litre, which can very well be regarded as an average value. The stallion therefore excretes 1,700,000 m.u. of œstrogenic hormone per diem.

These quantities of œstrogenic sex hormone in the urine of a male animal are particularly high when compared with other values as shown in the accompanying table:—

	Per litre (m.u.)	Per diem (m.u.)
Stallion	170,000	1,700,000
Mare	200	2,000
Pregnant mare	100,000	1,000,000
Sexually mature woman	30–200	45–300
Pregnant woman	10,000	15,000

On the basis of my earlier experiments, the urine of pregnant mares is now generally employed as the standard material for the preparation of œstrogenic hormone. The urine of the stallion, which is always procurable, will now also be available as a standard material for the œstrogenic hormone. A stallion produces 62 gm. of hormone in a year.

I found this mass excretion of hormone only in the male and not in the female horse. The determination of the hormone content, therefore, makes hormonic recognition of sex possible in the urine of a horse. In this connexion we find the paradox that the male sex is recognised by a high œstrogenic hormone content. If on examination, only 1 m.u. or even less hormone is found in 1 c.c. of horse's urine, the feminine sex may, as a result, be recognised. If 10 or more m.u. of œstrogenic hormone per c.c. of horse's urine are found, the masculine sex may be deduced.

In the urine of the castrated horse (gelding), I discovered only very small quantities of hormone, less than 0.3 per cent of the amount in the urine of the stallion. Similarly the young, sexually immature stallion (colt) excretes only very small quantities of hormone (about 0.2–0.5 per cent). These results appear to me to show that the testes of the horse must be held responsible for the production of the large quantities of hormone. By means of acetone-alcohol extraction I was able to demonstrate the presence of 23,100 m.u. in the two testes of a stallion, together weighing 350 gm. *These values show that the testis of the horse is the richest tissue known containing œstrogenic hormone.* According to my analyses, the hormonic content of both testes of the stallion is more than 500 times as great as that of both ovaries of a sexually mature woman and about 300 times as great as that of both ovaries of a sexually mature mare. The two testes of the horse, together weighing 350 gm., contain four to five times as much hormone as a human or horse's placenta weighing 500 gm. In contradistinction to the testis, the epididymis of the stallion contains no hormone (less than 10 m.u. in an epididymis weighing 5.4 gm.). In the fæces of the stallion I found quantities varying from 1,000 to 10,000 m.u. per kgm. The blood contains less than 800 m.u. per litre.

The mass excretion of œstrogenic hormone in the urine of a male animal is, according to the experiments I have so far carried out, a peculiarity of the equines. Thus, I found for the male zebra, 36,000 m.u., the Gravy zebra, 40,000 m.u., the ass (stallion), 3,300 m.u., and the kiang (Asiatic wild ass), 3,300 m.u. per litre of urine, whereas for the bull and the dromedary (stallion) less than 330 m.u. per litre of urine were found.

Similarly the high hormone content of the testes is to be found only among the Equidæ. In the two testes of a bull, together weighing 420 gm., less than 21 m.u. were found, that is, less than 0.09 per cent compared with horse's testes (horse's testes, 66,000 m.u. per kgm., bull's testes, less than 50 m.u. per kgm.).

It should be pointed out that the male sex hormone — as tested by the comb of a cock—is not excreted in increased quantities in the urine of the stallion. Gonadotropic hormone, prolan, and corpus luteum hormone are not excreted at all.

As is well known, œstrogenic hormone is readily soluble in all organic solvents. If human urine is shaken up with any solvent not miscible with water (ether, benzol), most of the hormone passes into the solvent. On the other hand, as I have already shown[2], the hormone in the urine of the pregnant mare cannot thus be extracted with these solvents. If, however, the urine is first made acid (to congo-red) with mineral acid and boiled for 5 minutes, then the hormone can be extracted with ether or benzol. As regards stallion's urine, I made the following observations:— If the untreated urine be shaken up with ether or benzol, hormone can be extracted, but only from 5 to at most 25 per cent is taken up by the ether. The main quantity of hormone can only be extracted if it is acidified and boiled for several minutes before extraction with ether or benzol. The hormone can be almost completely extracted from testicular tissue simply by treatment with ether or benzol. The alteration in solubility of the hormone described occurs, therefore, in the animal outside the testes.

The œstrogenic hormone which is excreted in the urine of the stallion shows so far exactly the same biological properties as are known in the case of the female sex hormone (follicular hormone, folliculin, œstrin). For example, growth of uterine muscle and proliferation of the uterine mucosa are enormously stimulated by even small quantities of stallion's urine. After five daily injections each of 0 5 c c of stallion's urine, the weight of the uterus of a young rabbit weighing 1200 gm. rose from 0 47 gm to 1 8 gm On introducing larger quantities of urine (twelve daily injections each of 3 c c of stallion's urine) the weight of the uterus rose from 0 47 gm to 5 48 gm and the weight of the vagina from 0 15 gm to 2 48 gm. The uterine musculature showed a great increase in muscle cells (hyperplasia), but especially great was the proliferation or what might be more correctly termed the hyperproliferation of the uterine and vaginal mucous membranes After the injection of stallion's urine there was a retardation of testicular growth in the infantile male rat (antimasculine reaction)

In such chemical properties as have hitherto been observed, the œstrogenic hormone in stallion's urine corresponds with follicular hormone, in which connexion attention is invited to its solubility described above We are now occupied with the exact characterisation of the hormone

The details of the investigations and the importance of the reported findings in relation to the biology of the sex hormones will be discussed in a comprehensive publication

I take this opportunity of expressing my best thanks to Sir Peter Chalmers Mitchell for the gift of material and to Dr Bernard Homa, of London, for the translation

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Jan 10

[1] *Klin Wochenschr*, No 49, 2285, 1930

[2] Die Hormone des Ovariums und des Hypophysenvorderlappens (The Hormones of the Ovary and of the Anterior Pituitary Lobe) Springer 1930, pp 85 and 90

A Source of Error in Photometry

In the course of spectroscopic work in this Institute, a source of error in photographic microphotometry has been discussed, which under certain conditions, especially in the case of band spectra, may be rather serious It is well known that the use of a wide photometer slit causes an error in the determination of the maximum blackening of a spectral line on the plate, the line appearing broader and less intense in the centre than by correct measurement with a narrow slit It is, however, easily overlooked that an error arises also in the integral intensity of the line, and since the matter, so far as we know, has not been dealt with in the photometric literature, it may be of interest to publish some calculations of the error under various conditions

For the sake of simplicity, we will assume that the blackening on the plate and the intensity of light are proportional, so that their integrals are equivalent For the distribution of intensity in the spectral line we choose the Gaussian function $i = i_0 e^{-k^2(\nu-\nu_0)^2}$ (i = intensity, ν = frequency, k = constant). The blackening S is as usual defined by $S = \log J_0/J$.

The curve S in Fig 1 represents the actual blackening on the plate, the curve J in Fig 2 is the photometer curve of the line when using an infinitely narrow slit. Using a slit of the width d means taking the mean J' of the function J in the interval $\nu \pm d/2$. It is easily seen that the integrals of the curves J and J' in Fig 2 are equal, that is, the area a is equal to the sum of the areas b. But when we calculate the blackening S' from the formula $S' = \log J'/J_0$, the area a will have a greater weight than the areas b, so that the area A in Fig. 1 becomes larger than the sum of the areas B. The integral of S' will always be smaller than that of S.

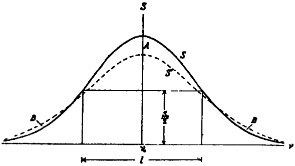

FIG 1

There are two factors which, under the chosen conditions, influence the magnitude of the error, namely, the maximum blackening S_0 and the ratio $p = d/l$ (l is defined in Fig 1) In the table given below, the error $\int_{-\infty}^{+\infty}(S-S')d\nu$ is given as a percentage of $\int_{-\infty}^{+\infty} S\,d\nu$ for different values of S_0 and p Since the mathematical treatment of the problem leads to insoluble integrals, the values of the error have been obtained by a graphical method and are, therefore, not very accurate

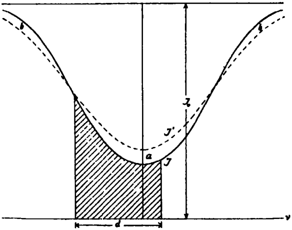

FIG 2

S_0 \ p	0 364	0 455	0 909
0 155	0 24	0 41	1 9
0 398	1 1	1 7	5 2
0 699	1 6	2 5	8·6

The tabulated values of the error may be very roughly taken together in the formula $\Delta = 16 . S_0 p^2$, though Δ is of course in reality a much more complicated function of both S_0 and p.

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Radiative Collisions of Neutrons and Protons

IT has recently been shown by Lea[1] that the passage of neutrons through paraffin wax and through liquid hydrogen gives rise to a gamma radiation of $1\text{–}6 \times 10^6$ e. volts energy, as well as recoil protons. As pointed out by Lea and Chadwick, the energy of these rays corresponds roughly to that which would be emitted in the radiative combination of a neutron and a proton to form a diplon We have therefore calculated the probability of such a radiative collision on the assumption that the neutron behaves as a fundamental charge-free particle throughout the collision, so that the radiation arises only from the acceleration of the proton by the field of force of the neutron. A dipole moment may then be associated with the system and the calculation carried out in the usual manner[2] The result is that, for the range of energies involved in the experiments, combination should not take place more frequently than once in every 1000 collisions (the effective radius for diplon formation is about 2×10^{-14} cm). This is much smaller than the observed frequency of about 1 in 4 collisions We have also calculated the probability of a proton radiating in the impact without binding taking place, and find it to be even smaller. These results do not depend appreciably on the form of interaction assumed between neutron and proton

It is of interest to note that if we assume that the neutron is a complex particle consisting of a proton and an electron, and that there are exchange forces between the neutron and proton of the type suggested by Heisenberg[3], then we obtain a much smaller probability of combination (of the order of one effective collision in 10^6), for with this model the dipole moment of the neutron-proton system vanishes[4] In view of the discrepancy between theory and observation, and also in view of the different efficiencies to be expected for the process according as the neutron is or is not a fundamental particle, it is clearly important to obtain additional information about the nature of the neutron-proton collision.

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[1] NATURE, 133, 24, Jan 6, 1934

[2] Mott and Massey, "The Theory of Atomic Collisions", p 229

[3] *Z Phys* , 77, 1 , 1932

[4] Mott and Taylor, *Proc Roy Soc* , A, 138, 665 , 1932

Remarkable Optical Properties of the Alkali Metals

IN a recent communication, Zener[1] has given an interesting interpretation of the peculiar optical properties of the alkali metals discovered by Wood[2], differing from that which I previously suggested in these columns[3]. A closer consideration of the problem has led me to the conviction that the viewpoint of Zener, although not fully accounting for all the observed facts in its original form, can serve as a suitable basis for the discussion of the phenomena in question if modified in the following way .

Zener starts from the assumption that the conduction electrons of the alkali metals are practically free. In the absence of temperature agitation of the lattice, they will then have only the one sharp resonance frequency, $\nu = 0$, and no resonance frequencies corresponding to quantum jumps from the occupied to the unoccupied stationary states. As stated by Zener, the dielectric constant of the metal at frequency ν is in this case given by

$$\varepsilon = 1 - \frac{Ne^2}{\pi m \nu^2},$$

where N is the number of conduction electrons per unit volume, e the electronic charge and m the electronic mass. The electrical conductivity σ, giving the current in phase with the electric vector of the radiation, on the other hand, is zero for all frequencies except for $\nu = 0$, where it becomes infinite The metal will hence be totally reflecting, even at perpendicular incidence, for all frequencies for which $\varepsilon < 0$, that is, below the frequency ν_0 given by

$$\nu_0^2 = \frac{Ne^2}{\pi m}. \qquad (1)$$

Zener tries to account for the results of Wood, according to whom the transparency of thin films of the alkali metals, in going towards shorter wave-lengths, becomes greater by a factor of the order 100,000 within a rather narrow frequency interval in the ultra-violet, by means of this phenomenon of total reflection, finding from (1) values of ν_0 which agree rather well with Wood's experimental data. The difficulty with this interpretation is that actually the alkali metals are by no means totally reflecting in the visible region, the coefficient of reflection in the case of potassium[4], for which the high transparency begins at about 3000 A., decreasing from about 90 per cent at 5000 A to about 10 per cent at 2500 A Wood's results must therefore with certainty be ascribed to a change in the coefficient of extinction rather than to a change in the reflecting power.

Now such a change in the extinction coefficient can be obtained on the same fundamental assumptions as introduced by Zener, if it be remembered that the resonance frequency $\nu = 0$ is not infinitely sharp but suffers a broadening due to the impacts of the conduction electrons with the metallic lattice, which the temperature agitation of the latter brings about. Specialising formulæ which I have given elsewhere[5] for the case of free electrons, the half breadth δ of the resonance line $\nu = 0$ is found to be

$$\delta = \frac{Ne^2}{2\pi m \sigma_0}, \qquad (2)$$

where σ_0 is the electrical conductivity for constant fields, while σ and ε are given by

$$\sigma = \frac{\sigma_0 \delta^2}{\nu^2 + \delta^2}, \quad \varepsilon = 1 - \frac{2\sigma_0 \delta}{\nu^2 + \delta^2}.$$

The index of refraction n and the coefficient of extinction $\varkappa$ are found from σ and ε by means of the relations[6]

$$n^2 = \tfrac{1}{2}\left(\sqrt{\varepsilon^2 + 4\sigma^2/\nu^2} + \varepsilon\right),$$
$$\varkappa^2 = \tfrac{1}{2}\left(\sqrt{\varepsilon^2 + 4\sigma^2/\nu^2} - \varepsilon\right).$$

In the table at the end of this letter I have computed the values of σ, ε, n and $\varkappa$ for potassium in the interesting region of wave-lengths, using $\sigma_0 = 1{\cdot}35 \times 10^{17}$, which leads to $\delta = 4{\cdot}11 \times 10^{12}$ according to (2). As may readily be seen, there exists a critical frequency below which n is abnormally small, while above it $\varkappa$ practically vanishes , the critical frequency with great approximation is equal to ν_0 as given by (1).

The vanishing of $\varkappa$ above ν_0 explains Wood's results Below ν_0, the values of n and $\varkappa$ may be compared with a few direct experimental determinations In the case of potassium[7], for wave-lengths 6650 A, 5890 A, 4720 A, n has the values 0 066, 0 068, 0 070, $\varkappa$ the values 1 77, 1 50, 1 00 The values of $\varkappa$ agree fairly well with the computed values, the values of n are indeed exceptionally small but still larger than the computed values by a factor 10. The discrepancies must evidently be ascribed to the fact that the electrons are not completely free as assumed If the electronic transitions, made possible by the binding, cause σ to be about 10 times as large as in the accompanying table, values of n agreeing more closely with experiment will be obtained, while the general behaviour of n and $\varkappa$ discussed above is not obliterated as in the case of other metals having a σ about 1000 times as large (for example, silver[8])

$\nu \times 10^{14}$	λ (A)	σ 10^{14}	ϵ	n	$\varkappa$
4	7500	14 3	− 5 94	0 0147	2 44
5	6000	9 13	− 3 43	0 0099	1 85
6	5000	6 34	− 2 08	0 0074	1 44
7	4286	4 66	− 1 26	0 0059	1 12
8	3750	3 57	− 0 733	0 0052	0 855
9	3333	2 82	0 370	0 0051	0 608
10	3000	2 28	− 0 107	0 0070	0 326
11	2727	1 88	+ 0 087	0 294	0 0058
12	2500	1 58	+ 0 233	0 483	0 0027
13	2308	1 35	+ 0 345	0 597	0 0017

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[1] C Zener, NATURE, 132, 968, Dec 23, 1933

[2] R W Wood, NATURE, 131, 582, April 22, 1933 *Phys Rev*, 44, 353, 1933

[3] R de L Kronig, NATURE, 132, 601, Oct 14, 1933

[4] "Int Crit Tables', 5, 253

[5] R de L Kronig, *Proc Roy Soc*, A, 133, 255, 1931 See eqs (6), (9) and (10)

[6] R de L Kronig, *Proc Roy Soc*, A, 124, 409, 1929 See eqs (6) and (7)

[7] 'Int Crit Tables", 5, 249

[8] R de L Kronig, *Proc Roy Soc*, A, 124, 409, 1929 See fig 2

Diffusion of Water in a Zeolite Crystal

IT has long been known that minerals of the zeolite family show remarkable properties which indicate that certain constituents of the crystal lattice are movable The exchangeability of cations and the possibility of driving out the water of constitution and substituting it with other substances in a reversible way without spoiling the crystal can be understood only by such an assumption X ray structure determinations have shown that zeolite lattices contain wide meshes, through which a migration of matter may very well be assumed to take place[1]

I have made an attempt to study this migration quantitatively For this purpose I have chosen an optical method, which makes a direct observation of the migration possible The reversible dehydration and the substitution of the water of constitution with other substances bring about characteristic changes in the optical properties of the zeolites. The refractive index, the extinction angle, and the double refraction may change considerably

When studying the rehydration in moist air of partially dehydrated crystals of heulandite between crossed nicols in the polarising microscope, Rinne, Gaubert[2,3] and others have observed a diffuse black band, parallel to the surface, slowly migrating from the surfaces towards the interior of the crystal. The position of the black band is dependent upon the angle between the crossed nicols and the crystal axes For any value of this angle, those parts of the crystal that have a water content corresponding to this extinction angle will appear black No quantitative study of the phenomenon has, however, been made so far

I have been able to confirm these observations When using monochromatic light and strongly dehydrated crystals, I have observed as many as seven bands, the number depending upon the degree of dehydration, the thickness of the crystal, and the wave length of the light These bands (except that nearest the edge, which evidently is identical with the above mentioned extinction angle band) do not move when the nicols are turned and are evidently due to the change in double refraction known to accompany the dehydration Each band corresponds to a water content with a double refraction giving a phase difference of $n\lambda$. If we know the exact relation between water content and extinction angle or double refraction, a very detailed analysis of the distribution of water in the crystal after different times of diffusion can be made, for example, by measuring the position of all the bands with an ocular screw micrometer The extinction angle band can be used only for the highest water content, since the angle is independent of the change in water content, except for the last few per cent entering the crystal. In all other cases the double refraction bands have to be used

Of course all quantitative measurements must be made in a vacuum Heulandite crystals, carefully selected to secure material as optically homogeneous and free from cracks as possible, were ground to thin plates parallel to the cleavage plane Such a crysta was placed in a specially constructed vacuum microcuvette, which could be connected to an evacuated container with air-free water, kept at constant temperature in a thermostat The cuvette could be heated

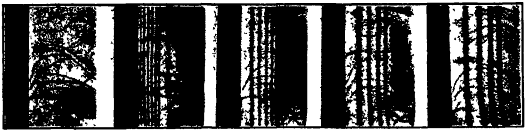

FIG 1

to any desired temperature with a small, closely fitting electric oven. The temperature of the crystal was measured with a thermocouple

Sorption isobars of water in heulandite at different pressures and temperatures were determined with a sorption balance apparatus to be described elsewhere By varying the temperature of the crystal and the water vapour pressure in the cuvette, the crystal could thus be given any accurately known water content, and the corresponding changes in the optical properties could be determined

Diffusion experiments were made in this apparatus with crystals dehydrated by different amounts When the crystal had attained equilibrium, the stopcock to the water container was opened, and water vapour of a constant, accurately known pressure was let in Observations were made in monochromatic light from a Pirani sodium lamp. *Fig* 1 shows a series of photomicrographs from such an experiment

The measurements show that the displacement of each band is proportional to the square root of time, in agreement with the requirements of the general diffusion equation $\delta c/\delta t = \delta/\delta x\ (D\frac{\delta c}{\delta x})$ (Boltzmann[4]) Calculation of the diffusion constant *D* from the observations on each band shows that there is a strong drift of *D* with the concentration At 20° C in a direction normal to the face *t* (Des Cloiseaux notations), the constant varies from $3\ 2 \times 10^{-7}$ to $8\ 9 \times 10^{-7}$ cm ^{2} sec $^{-1}$, while the concentration increases from 12 0 to 17 5 per cent. The diffusion shows a strong anisotropy, being immeasurably small normal to the cleavage plane and showing in this plane a minimum value normal to the face c (Fig 2) The ratio between the maximum and minimum values in this plane corresponding to the 'diffusion ellipse' is 12 5

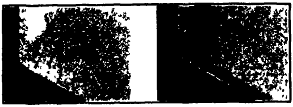

FIG 2

It is planned to study the diffusion of other gases, and also to use other zeolites, in the first place some of those for which complete X-ray structure determinations have been made. Investigations of this kind bear some relationship on the well-known surface diffusion studies[5,6]. In both cases the diffusing molecules meet vacant lattice points in their path

A detailed report of the investigation and a discussion of the results will appear shortly.

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[3] P Gaubert, *Bull. Soc. Franc Mineral*, 52, 162, 1929

[4] L Boltzmann, *Ann. Physik*, 53, 959, 1894

[5] M Volmer, *Trans Far Soc*, 28, 359, 1932

[6] I. Langmuir, *Phys. Rev*, 44, 423; 1933

Weiss Constant of Paramagnetic Ions in the *S*-State

THE influence of crystalline and molecular fields on the magnetic behaviour of paramagnetic ions has formed the subject matter of several theoretical papers by Bethe, Van Vleck and others[1]. In the case of ions in the *S*-state (for example, Mn++), the susceptibilities of which are due wholly to the *spin* moments of their electrons, the theory leads to the following result the Weiss constant θ, appearing in the well-known relation $\chi = C/(T-\theta)$, is zero; that is, the susceptibilities of these ions conform to the simple Curie law of inverse dependence on absolute temperature This result has been fully verified experimentally by Jackson[2] and others in the case of manganous salts *in the solid state* But, for these salts *in aqueous solution*, in which state one would, *a fortiori*, *expect this result to hold true*, the experimental data at present available[3] do not follow this rule, they yield large values for θ, namely, 24-28 for the ion in $MnCl_2$, and 22-27 for the ion in $Mn(NO_3)_2$

I have therefore made some extensive measurements with aqueous solutions of these salts, of various concentrations, from room temperature to about 98° C In all cases I find that the susceptibility of the Mn++ ion obeys the simple Curie law, the maximum value of θ obtained in these measurements was less than 3

The Curie constant, *C*, of the Mn++ ion, obtained in these measurements, was 4 19 per gm ion in $MnCl_2$ solutions, and 4 11 per gm ion in $Mn(NO_3)_2$ solutions These correspond to 28 8 and 28 5 Weiss magnetons respectively, as against previous values of 28 1 for solution and 29 0 for solid

A detailed report of this work, which was carried out under the guidance of Prof K S Krishnan, will be published in the *Indian Journal of Physics*

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[1] Van Vleck, "Theory of Electric and Magnetic Susceptibilities", Chap xi

[2] *Proc Roy Soc*, A, 140, 695, 1933

[3] See "Int Crit Tables", 6, p 351 (In Table 13, the signs prefixed to the values of θ for the manganous salts should be *positive*)

Photo-Oxidation of Nitrite to Nitrate

THERE is considerable difference of opinion regarding the possibility of the oxidation of nitrites by oxygen to nitrates Berzelius reported that when aqueous solutions of alkali nitrites are boiled in air, they absorb oxygen with the formation of nitrates. G Lunge and E Frémy, J. Lang[1] and others showed that aqueous solutions of nitrites pass into nitrates. According to R. Abegg and H Pick[2], oxygen of the air oxidises a solution of silver nitrite to silver nitrate. On the other hand, E Divers[3], Sir P C. Rây[4], C Russworm[5], M Oswald[6], and others observed no oxidation of solutions of nitrites in air C Matignon and G Marchal[7] reported that an aqueous solution of sodium nitrite is not oxidised by prolonged contact with oxygen, under a pressure of 50-55 atmospheres, even in the presence of a catalyst But when the pressure is raised to 175 atmospheres and temperature to 395°-530°, solid sodium nitrite is almost completely oxidised to nitrate.

The formation of nitrates from nitrites in acidic solution is easily explained from the point of view that the solution of nitrous acid undergoes the following change

$$3\,HNO_2 \rightleftarrows HNO_3 + 2NO + H_2O.$$

In presence of air, the nitrous acid may be completely converted into nitric acid This seems to be the explanation of the observation of A. Muntz[1] regarding the conversion of nitrites to nitrates in soil, in presence of carbonic acid and air Dhar[2] and collaborators have shown that solutions of sodium nitrite can be appreciably oxidised to sodium nitrate by passing air in presence of inductors like ferrous hydroxide, sodium sulphite, etc , and the amount of oxidation increases with the increasing concentrations of the inductor and the nitrite solution and with the time for which air is passed W P Jorissen and C van den Pol[10] and W Reinders and S I Vles[11] could not detect any oxidation of sodium nitrite by oxygen in presence of sodium sulphite because they did not take sufficient sodium sulphite and the contact with oxygen was not long enough

Recently we have observed that dilute solutions of sodium nitrite or potassium nitrite, when exposed to sunlight and air, are oxidised to nitrate The velocity of the photochemical oxidation is greatly accelerated by the presence of titanium, zinc and iron oxides (TiO_2, ZnO and Fe_2O_3) Titanium oxide seems to be the best photosensitiser. The following are some of the results obtained by us

Concentration of nitrite	Volume exposed	Time of exposure	Catalyst	Per cent nitrite unchanged	Amount of nitrogen obtained after exposure
		Sodium Nitrite			
N/525	100 c c ≡ 0 00132 gm nitrogen	100 hours	5 gm TiO_2	0	0 00126
,,	,,	,,	5 gm Fe_2O_3	0	0 00126
		Potassium Nitrite			
N/112 4	100 c c ≡ 0 00620 gm nitrogen	100 hours	5 gm Fe_2O_3	0	0 00618

Warburg[12] and Villars[13] studied the photodecomposition of solutions of potassium nitrate in ultra-violet light Dhar and Sanyal[14] observed the slow decomposition of nitrates in sunlight The photodecomposition of potassium nitrate is a slow reaction and has a low quantum yield in ultra-violet light and tropical sunlight It seems, therefore, that in presence of light, the following equilibrium is obtained .

$$2KNO_3 \rightleftarrows 2KNO_2 + O_2$$

It appears that in dilute solutions and in presence of an excess of oxygen, practically the whole of the nitrite is oxidised to nitrate in light From the foregoing observations it seems clear why discordant results regarding the oxidation of nitrites to nitrates by different workers were obtained. Experiments done in laboratories having more diffused light probably resulted in greater oxidation of the nitrite.

In publications from this Laboratory[15], it has been shown that amino acids can be readily oxidised to ammonia in presence of air and light. Also, ammonia and its salts are oxidised to nitrites in presence of surfaces like titanium and zinc oxides, sterilised soil, etc , in the complete absence of bacteria, when exposed to air and sunlight. We have now observed that nitrites can also be oxidised photochemically to nitrates in the absence of bacteria It appears, therefore, that the important processes of ammonification, nitrification and the conversion of nitrite to nitrate taking place in soil, which have been ascribed so far solely to bacterial activity, can be induced in presence of sunlight Hence we are of the opinion that these processes can be photochemical rather than bacterial, specially in tropical countries where the number of bacteria is small, being mostly killed by the high temperature of the soil during the summer months

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[6] *Ann Chim Phys* , (9), 1, 32 , 1914
[7] *C R* , 170, 232 , 1920
[8] *ibid* , 112, 1142 , 1891
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Anisotropy of Spherical Sound Waves

THE amplitude of vibrations on the wave surface of a spherical light wave may, or may not, be homogeneous. According to the classical electromagnetic theory of light, for a spherical wave emitted by a linear oscillator, the intensity is at a maximum in the direction perpendicular to the axis of the oscillator, and at a minimum in the direction of prolongation of the axis.

It is interesting to find experimentally whether the distribution of intensity of a spherical sound wave is homogeneous or presents any analogous anisotropy

To test this, the intensity of sound emitted during spark discharges is measured by means of a Rayleigh disc suspended in the stream of the sound wave. The discharge is produced in a circuit which consists of an alternating current transformer with four Leyden jars joined in parallel with a spark gap, which is formed by two thin steel rods placed at several millimetres distance along a straight line The steel rods are 2 mm in diameter This small size was adopted in order to diminish any possible disturbance due to massive solid obstacles placed in the path of the sound wave. The transformer is used instead of an induction coil, because the latter needs a mechanical interrupter which produces undesirable noises when it is working. The spark gap is mounted on a rotating table provided with a scale, such that the gap can rotate around its centre and its orientation can be determined accurately from the scale

Observations were made of the deflections of the disc for different orientations of the spark. The deflections were proportional to the intensity of the incident sound wave. Hence the relative intensities around a great circle on the spherical wave surface can be determined Special attention was paid to making the discharge as uniform and constant as possible. A large number of observations was carried out. Some typical results when the gap is 6 mm.

in length and the disc is placed at a distance of 68 cm. from the spark are given below.

θ	0	90	180	270	360
d	0 803	1 09	0 80	1 07	0 81
I	1 00	1 36	1 00	1 33	1 01

θ = the angle between the direction of observation and the direction of the spark
d = the deflection of the Rayleigh disc
I = the relative intensity of sound

These results show definitely that the intensity of spherical sound waves emitted by a spark is distributed anisotropically on the wave surface: the intensity is a maximum in the direction perpendicular to the direction of the spark and a minimum in the direction of prolongation of the spark

The experiments are being continued with different methods of measuring the intensity of sound, and a more detailed report will appear shortly

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Crystal Structure of Copper Sulphate

We have been able to determine the structure of copper sulphate pentahydrate, which was the first crystal used by Friedrich and Knipping to diffract X-rays The unit cell has dimensions ·

$$a_0 = 6\ 12\ \text{A.},\ b_0 = 10\ 7\ \text{A},\ c_0 = 5\ 97\ \text{A},$$
$$\alpha = 82°\ 16',\ \beta = 107°\ 26',\ \gamma = 102°\ 40,$$

and contains two molecules of $CuSO_4\ 5H_2O$ The only symmetry possessed by the crystal is a centre of inversion

The copper atoms lie on the centres of symmetry at (0 0 0) and ($\frac{1}{2}$ $\frac{1}{2}$ 0) and the sulphur atoms on the general position (0 01, 0 29, 0 64) Each copper atom is surrounded by an octahedron consisting of four water molecules and two oxygen atoms, suggesting that there are direct bonds from copper to oxygen. This differs from structures like $BeSO_4\ 4H_2O$ and $NiSO_4\ 6H_2O$, in which the bonds joining the groups are between water and oxygen[1]. That the two octahedra are not equivalent is the explanation of the dehydration to $CuSO_4\ 3H_2O$ and then to $CuSO_4\ 1H_2O$.

The odd water molecule touches two oxygens of different SO_4 groups and two waters of different octahedra, and would seem to play an important part in holding the structure together The structure satisfies all the generally accepted requirements of inter-atomic distances.

The copper and sulphur positions were obtained from rotation photographs of copper sulphate and copper selenate crystals, and the oxygen and water positions from a double Fourier synthesis projecting on to (001)

We have to thank Prof. W. L. Bragg for allowing us to make the necessary measurements with the X-ray spectrometer at Manchester. We hope to publish further details elsewhere.

C. A Beevers.
H Lipson.

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Jan. 3

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[1] *Z. Krist.* (A), 82, 297; 1932. 83, 123, 1932

The so-called Terminal Parenchyma Cells in the Wood of *Terminalia tomentosa*, W. and A.

In the literature dealing with European and American timbers, frequent mention has been made of the presence of terminal parenchyma cells in the wood of *Fraxinus excelsior*[1], *Populus* sp [2], *Betula lutea*[3] and *Acer sachharum*[3]. There can be no doubt about the validity of these statements, for they were based on intensive study of those timbers both in the field and in the laboratory

While dealing with Indian timbers, Brown[4] has mentioned the presence of terminal parenchyma cells in the wood of *Terminalia tomentosa*, W and A I have done the same on one occasion[5]. But none of these statements was based on the results of studying wood taken out periodically from a living tree and actually finding out whether these parenchyma cells were terminal or not From the examination of the timber of this species in the laboratory, some of the parenchyma cells appeared to be distributed in the same way as the terminal parenchyma cells in the wood of *Fraxinus excelsior, Betula lutea*, etc, and they were, therefore, described as terminal.

During the last three years, however, while studying the formation of growth rings in the wood of *Terminalia tomentosa*, W and A, I have found that the so-called terminal parenchyma cells are not really formed as the last tissue of the annual ring, but are the first type of cells formed at the beginning of the growth season So, instead of being terminal, they are actually initial

So far as my information goes, no textbook has mentioned this type of parenchyma distribution in any wood Details of this investigation will soon be published. Meanwhile, it would be interesting to know whether anyone else has noticed this type of parenchyma cell distribution in any wood.

K A Chowdhury

Forest Research Institute,
Dehra Dun, India.
Dec 14

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[1] Chalk, L and Rendle, B J, "British Hardwoods, their Structure and Identification" (*For Prod Res Bull* No 6, p 12, 1929)

[2] Jeffrey, E C, "The Anatomy of Woody Plants" (University of Chicago Press, p 51-52, 1917)

[3] Lodewick, J E, "Seasonal Activities of Cambium in some North-Eastern Trees" (*Tech Bull* 23, Syracuse University, N Y, p 29, 31)

[4] Pearson, R S and Brown, H P, "Commercial Timbers of India", vol 1, p 520, 1932

[5] Chowdhury, K A, "The Identification of Important Indian Sleeper Woods" (*For Bull* No 77, p 14, 1932)

White Cats and Deafness

Mrs Bamber's recent article in the *Journal of Genetics*[1] on the correlation between white coat colour, blue eyes and deafness in cats is of importance and interest It may perhaps be supplemented by a brief note on the same subject

Mrs. Bamber states: "It has long been recognised that blue-eyed white cats are often deaf, whereas white cats with yellow or greenish eyes have normal hearing." She records the existence of a white, blue-eyed male cat which is not deaf. Another case is that of a cat with one blue and one yellow eye, which is "completely deaf on both sides."

I have at present a male, polydactylous, white cat with yellow eyes, which is completely deaf on both sides. This animal completes the possible combination of eye colour, deafness and normal hearing. As yet this animal is too young to breed. It is hoped, however, that he may, in the near future, be tested genetically

In the meantime the correlation between blue eyes and deafness is certainly not a perfect one If the two characters are due to a similar physiological or genetic agent, it seems certain that its effects are sufficiently variable to enable them to operate in either the eyes or the ears, to the exclusion of the other location

C C LITTLE

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[1] Bamber, R C, *J Genetics*, 27, 407-413, 1933

Spawning Date of the Common Frog

IN a former communication[1] I announced certain conclusions on the effect of the weather upon the spawning date of the common frog, *Rana temporaria* Since then, a number of new facts have come to light

Although wet days and spawn days are not associated, rainfall affects the date of spawning The effect, parallel to the temperature effect previously reported, is due mainly to the total rainfall of the month prior to spawning.

These conclusions are confirmed by the relation which exists between the altitude of a pond and its spawn date In south-west England, spawning is, on the average, earlier the higher the pond observed In the Midlands and in south-east England, the same is true but the effect is much less This distribution, both altitudinal and geographical, is the same as that of orographical rainfall.

The view that the weather is acting directly on the frogs themselves conflicts with my observations on migration Although frogs hibernate in a variety of situations, they arrive at a particular breeding pond from different directions simultaneously, although this pond may differ considerably in its spawn date from another close by There is, moreover, a difficulty in accepting a long period rainfall effect acting directly on frogs hibernating under water The pond seems to be the unit for both spawning and migration, probably two aspects of one problem

The observations suggest that spawning is dependent on pond periodicity It is known that the periodicity of pond plants is affected by temperature and especially rainfall, which acts by the washing of phosphates from the soil into the pond[2] Atkins, in the paper cited, found that ponds with streams running into them developed their algal maxima earlier than the others, due to the increased phosphate supplies, and I found, from the results of a postal questionnaire, that ponds without streams tended to be without frogs

The link between algal (or other plant) periodicity and spawning is being sought in the production of odour by the water plants The smell of standing water is a problem of water-works technology, with a large literature, which has received little attention from workers on the migration of terrestrial animals breeding in the water. The odours are, in general, not those of decay, but are due to essential oils secreted by the water plants, plankton, etc, and are markedly periodic in their occurrence.

An endeavour was made last season to see whether plankton was responsible by asking a number of observers to send me samples of the water of their ponds, from which I concluded that planktonic organisms are not concerned. An attempt is being made this spring to correlate phosphate changes in the water with spawning.

The form of the generalised curve showing the progressive changes in the number of ponds in an area having spawn is deducible from some simple assumptions on the mechanism, and the reasoning shows that the date on which the maximum number of ponds develop the postulated effect will not be coincident with the date on which the maximum number of spawn reports occur, but will be later

A detailed account will be published later.

I wish to thank those phenological observers who took so much trouble in the postal scheme, and the Royal Meteorological Society for data courteously supplied.

R MAXWELL SAVAGE

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Jan 6

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[1] Savage, NATURE, 131, 587, April 22, 1933
[2] Atkins, *J Marine Biol Assoc U K*, 13, 110

A Recent Sedimentary Volcanic Tuff

ON November 3, 1931, during a trawling survey of Falkland Island waters, the R R S *William Scoresby* made a haul with a commercial trawl in 98 m of water on a position 45° 56′ S., 66° 24′ W. situated in the Gulf of San Jorge, off the Patagonian coast

The contents of the trawl consisted mainly of several bushels of slabs, 5–10 cm. thick, of a compact clay-like rock. Its colour was greenish-grey changing to olive-buff when dry Under the microscope, the rock is seen to consist of some very finely divided 'clay' substance, too finely divided to be identified by means of the polarising microscope, but a much more abundant constituent is colourless volcanic glass in flakes varying in size from 0·15 mm downwards With this are birefringent grains of feldspar (varying in size from 0 06 mm in diameter downwards) and a very few green grains resembling glauconite The colourless glass and the feldspar are similar to the material which forms the dust clouds emitted by volcanic eruptions in the Andes and has on occasions travelled the whole breadth of the Argentine Republic In dust collected at Buenos Aires after the eruptions in the Andes in 1932, the particles ranged from 0 2 mm downwards for the colourless glass, and from 0 1 mm. downwards for the chips of feldspar and other minerals. There seems no doubt that the rock has been formed by the deposition in the sea of volcanic dust windborne from the Andes. If so, it is an excellent example of the mode of deposition of some of those sedimentary volcanic tuffs which have long been known among deposits of volcanic origin.

The associated fauna was very meagre, consisting almost entirely of an alcyonarian of the genus *Renilla* together with a few polychætes

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Jan. 18.

Quaternary Intermetallic Compounds

INVESTIGATORS of metallic systems by thermal and X-ray methods have found many binary intermetallic compounds; they have found, however, only a few ternary and no quaternary compounds. If a metal or metals of one class (zinc, tin, cadmium, mercury) reacts in mercury at ordinary temperature with one of another (copper, iron, cobalt, nickel, manganese), many binary and ternary compounds result[1].

Recently we have succeeded in getting three of the first class to unite with copper to form reasonably stable quaternary compounds, the analysis of which by the volumetric processes of the laboratory presented no difficulty Seven of them were obtained by the reaction between zinc and the simplest ternary compound which forms in mercury, namely, $SnCu_3Hg_7$ Their approximate empirical formulæ are $Sn_4Cu_{12}Zn_4Hg_8$, $Sn_5Cu_{15}Zn_5Hg_9$, $SnCu_3ZnHg_8$, $SnCu_3ZnHg_6$, $Sn_4Cu_{12}Zn_4Hg_{48}$, $Sn_4Cu_{12}Zn_7Hg_{21}$ and $Sn_4Cu_{12}Zn_7Hg_{33}$ Four others have been prepared by the reaction between tin and the simplest binary compound which forms in mercury, namely, ZnCu Their approximate empirical formulæ are $Zn_3Cu_3SnHg_7$, $Zn_6Cu_6SnHg_9$, $Zn_{40}Cu_{40}Sn_5Hg_{14}$ and $Zn_{40}Cu_{40}Sn_{12}Hg_{31}$ Cadmium forms ternaries with copper and mercury without difficulty but not with copper and zinc or with copper and tin. Quaternaries or quinaries including cadmium cannot, in consequence, be so prepared.

Ternary and quaternary compounds formed in mercury, so far as the work has gone, may be regarded as derived from known compounds of mercury and copper in which other metals of the *B* sub-group of the Periodic Classification partly replace the mercury, an atom of the quadrivalent tin counting as two divalent atoms of mercury, zinc, cadmium and mercury being equivalent Thus $SnCu_3Hg_7$, $SnCu_3ZnHg_6$ and $Sn_4Cu_{12}Zn_7Hg_{21}$ may be regarded as derived from $CuHg_3$, a compound which has been prepared in mercury but otherwise is unknown in metallurgy. (The corresponding $CuZn_3$, however, is well known) Similarly, $Sn_5Cu_{15}Zn_5Hg_9$, $Zn_{40}Cu_{40}Sn_5Hg_{14}$, and the ternaries (not mentioned above) $Zn_2Cu_5Hg_6$ and $Zn_4Cu_5Hg_4$, may be regarded as derivatives of Hg_8Cu_5, which has been prepared in mercury. (The corresponding Zn_8Cu_5 and Cd_8Cu_5 are well known in metallurgy)

If this process of derivation is legitimate, our work is brought into line with that done by thermal and X-ray methods. In addition to the binary compounds which form easily in mercury or by other methods, there is the possibility of a large number which do not Their existence, possible and actual, has enabled us to confirm and extend considerably the rules connecting the numbers of valency electrons and atoms which were put forward first by W Hume-Rothery[2], namely, for compounds between such metals as tin, zinc or cadmium and metals like copper, silver or iron, there are characteristic ratios of valency electrons to atoms of 3 : 2, or 21 · 13 or 7 · 4, that is to say, for 21 electrons there may be 14, 13 or 12 atoms in the compound. We find for a given number of electrons there are ranges of atoms. For copper united with a divalent metal of the *B* sub-group there may be for 42 electrons 21, 22, 23, 24, 25, 26, 27 or 28 atoms; for 18 electrons 12, 13, 14, 15 or 16 atoms. In tin-copper compounds, for 42 electrons there may be 14, 15, 16, 17 or 18 atoms, for 28 electrons, 12, 13, 14, 15 or 16 atoms and for 21 electrons, 12, 13 or 14 atoms It would thus appear that the total number of valency electrons—18, 21, 28 or their multiples—is even more characteristic of an intermetallic compound than the ratio of electrons to atoms

In reckoning valency electrons, metallurgists count copper and silver as having each one electron, zinc, cadmium and mercury as having each two electrons, and lead and tin as having each four. To fit transition metals like iron, cobalt and nickel into the schemes, they regard their atoms as contributing no valency electrons to the compound Our results show, however, that in certain compounds (mainly when these metals are in excess) iron, cobalt, nickel, manganese, and possibly other transition and pre-transition metals of the Periodic Classification, may be regarded as having each one electron, in other compounds (mainly when the *B* metal is in excess) the transition metal acts as if it had no electron Thus, in $SnFe_3$, iron acts as if it had one valency electron; in $Zn_{21}Ni_5$, nickel acts as if it had no valency electron.

My former pupil, Mr R. P. Lawrence, has helped me in this work

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Jan 17

[1] Russell, Cazalet, Irvin, Lyons, Kennedy and Hewitt, *J Chem Soc*, 841, 852, 857, 2340, 1932 NATURE, 125, 89, Jan 18, 1930

[2] *J Inst Metals*, 35, 295, 1926 *Annual Reports of Chemical Society*, 27, 294, 1931

Passage of Hydrogen through Steel

INVESTIGATIONS have recently been carried out by Dr J M. Bryan and myself at the Low Temperature Research Station, Cambridge, on the relative rates of corrosion by dilute solutions of citric acid of different samples of mild steel sheets such as are used in the manufacture of tin-plate In these tests an attempt was made to eliminate edge-corrosion by making the steel sheet the bottom of the corrosion chamber. This was done by cutting off the bottoms of glass bottles, grinding the edges and coating them with pure vaseline to prevent leakages, and applying the sheet The whole was clamped up tightly in a suitable frame, the sheet itself being in contact on its outer side with a pad of filter paper resting on a wooden block The chamber thus formed was connected to a gas burette so that the hydrogen formed through the action of the dilute acid could be measured, and the whole apparatus was held at 25° C

It was found after a given period that the loss in weight of the sheet indicated that the hydrogen-equivalent of the steel dissolved was far in excess of the hydrogen actually collected This excess was greater than could be accounted for through solution of the hydrogen in the corroding medium, and it appeared therefore that the hydrogen was either absorbed by the metal in considerable qualities or else passed through it and was evolved freely on the outer side. That the latter was more probable was supported by the fact that blisters appeared on the outer side of some of the specimens, showing that the gas passed, at any rate, nearly through the metal and could exert considerable pressures inside it.

A further experiment was therefore carried out in which the metal sheet was clamped so as to form a diaphragm between two flanged hemispherical glass vessels each of which was connected to a gas burette by means of an outlet tube The upper vessel contained the corroding medium which was in contact with the metal and the lower one contained air The air in the headspace of the upper chamber and in the solution was replaced by nitrogen and the whole apparatus was set up in a room held at 25° C

Both the upper and lower burettes soon began to register an increase in volume That in the upper one was the more rapid at first, but slackened later, and when the apparatus was taken down after two days, there was about 30 c c of hydrogen on either side, leaving about 9 c c (calculated from the loss in weight of the sheet) to be accounted for by absorption into the metal and by solution in the citric acid I should be glad to know whether the passage of hydrogen through steel under similar conditions to the above has been recorded

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Interaction of Radio Waves

THE phenomenon recently reported by Tellegen[1] whereby the new broadcasting station at Luxembourg appears to interact with that portion of the carrier wave of the Beromunster station which is received in Holland, can be explained by taking into account the effect of such a powerful station (200 kw and $\lambda = 1190$ m) on the mean velocity of agitation (u) of the electrons in the ionosphere Any change in u will produce a change in ν, the frequency of collision of an electron with molecules, and hence a change in the absorbing power of that part of the ionosphere in the vicinity of the station Since this change depends on the magnitude of the electric vector in the disturbing wave, it follows that the absorbing power of this part of the ionosphere will vary in accordance with the modulation frequency of the station, and so the modulation will be impressed in part on any other carrier wave which may traverse this region

We have examined these points quantitatively with the help of data obtained by Townsend and Tizard[2] on the motions of electrons in air, and have arrived at the following conclusions

The amount of modulation of a carrier wave produced by a disturbing station of power P and modulation frequency f is approximately proportional to P and inversely proportional to f There is thus introduced a distortion of the original modulation, at the expense of the higher frequencies of modulation

The variation of the impressed modulation with the wave length of the disturbing station is more complicated, being roughly proportional to $1/\{\nu^2+(p-\omega)^2\}$ where $p = 2\pi c/\lambda$, $\omega = H_p e/cm$ and H_p is the component of the earth's magnetic field perpendicular to the electric vector of the disturbing wave It is clear that the quasi-resonant state ($p = \omega$) can exist only in very localised regions of the ionosphere, and will contribute little to the total impressed modulation, which may be received over the whole path of the wave in the absorbing regions of the ionosphere The disturbance will therefore be greatest when ω is small, that is, when the entire electric vector of the wave lies in the direction of the earth's magnetic field The magneto-ionic theory shows that under European conditions this can occur only for that part of the wave's path which is roughly horizontal In such circumstances ω will always be small for waves much longer than 214 m

We have examined the magnitude of the disturbance which would be experienced at Eindhoven when listening to the Beromunster station, and find that it would become appreciable for values of air pressure in the absorbing regions near those generally accepted The disturbance experienced is proportional to ν^2, so that we should expect increased disturbance at times when the sky wave is weakened by increased absorption, for example, around sunrise and sunset, and in the daytime if signals be audible

It is to be anticipated that the Warsaw station will also exhibit the effect in just appreciable intensity if careful investigation be made It is not to be expected, however, that the very long wave high-power telegraph stations, such as Rugby or Nauen, could produce the effect, for such long wave-lengths are probably reflected at a level in the ionosphere below that which absorbs waves of broadcasting frequencies Neither would such a station appreciably influence the reception of other very long wave stations, since most of the received signal on these wave-lengths is due to the ground wave

The details of our investigation will be published elsewhere in the near future, together with a discussion of the possibility of utilising the phenomenon to derive further information about the ionosphere

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Nov 29

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[1] NATURE, 131, 840, June 10, 1933

[2] *Proc Roy Soc*, A 88, 336, 1913

Audibility of Auroras and Low Auroras

I WAS much interested in the article "Audibility of Aurora and Low Aurora" by F T Davies and B W Currie which appeared in NATURE of December 2, because I once witnessed an aurora and heard the swishing sounds referred to

During the winter of 1908–1909, while attending Trinity College at Hartford, Conn , I observed a magnificent aurora The light effects gave me the impression that the atmosphere was filled with fog, and that someone was illuminating it by playing a searchlight back and forth The effect was very striking because the display was so close to the ground that I seemed to walk right through the illuminated fog

The sound which I heard is exactly described by the word swishing I do not believe I could say the swishing sound was in unison with the flickering of the lights because the sight was so new and strange that I did not observe it from the point of view of a scientist. All that I can say is the swishing sounds were heard while the lights were changing.

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Jan. 4

Research Items

Clay Heads from Ashanti. Capt. R. P. Wild describes and figures in *Man* for January two heads of baked clay from Fomena, Ashanti, which were obtained by Mr. E. A. Burner, of the Political Service, from Nana Kobina Fori, the Omanheno of Adansi, whose capital town is Fomena. Kobina Fori, whose age is estimated at somewhere in the neighbourhood of eighty years, states that although these heads are not now made, he remembers them being made by an old woman when he was a boy. According to his evidence, they were placed on the graves of chiefs, elders, councillors and queen mothers, that is, the most prominent members of the Adansi tribe. At certain times offerings were made to the spirits which were supposed to have taken up their abode in the heads. For this purpose a baked clay ladle was required. The heads are well fired and are made of a fairly fine clay. They are hollow and almost life size. From the absence of the beard and the smaller head it is probable that one of the two heads represents a woman. The features of both heads are rather refined in comparison with the usual cast of countenance in the Ashanti race. This supports the statement that they are meant to represent chiefs, elders, etc., as the ruling classes of the Ashanti show distinct signs of refinement. The side view shows the typical long face of the Ashanti, but with an unnatural flattening of the back from the nape of the neck upward, giving an almost vertical profile. This may be due to artistic license. The conventional representation of the hair is interesting, it being rendered by whorls, cylinders and hollow balls. Kobina Fori stated that human hair (perhaps the hair of the deceased) was inserted in the holes in the cylinders and balls. The faces had been coated with red clay after firing, red being the mourning colour of the Ashanti. Facial markings, it is suggested, may be intended to counterfeit the cicatrices of an Akim slave as a disguise against evil spirits.

Cancer Mortality in the Australian Commonwealth. Deaths from cancer in the Commonwealth of Australia for 1931 per 100,000 of mean population were for males 105, females 97, persons 101 (Dr. M. J. Holmes, *J. Cancer Res. Com. Univ. Sydney*, 5, No. 3, 168; 1933). These rates show a considerable increase on those of the previous year and affected all States except Western Australia. The age-grouping of the population has, however, been altering since 1921, and the proportion of the population in the age-groups 45–64 and over 65 years is now larger than in a standard population, that is to say, a larger proportion of the population reach the 'cancer age' than formerly. Correcting for this, an actual diminution in the cancer mortality in the age-groups below 65 years has become evident in recent years, the rate for 1931 being lower than that for 1921 and for 1911. This diminution may justly be attributed, at least in part, to the efficacy of modern treatment. The mortality rate for sarcoma remains at about the same figure that it was twenty-five years ago.

Golgi Apparatus in Protozoa. Joyce C. Hill (*J. Roy. Micr. Soc.*, 53, Part 3, 1933) states that the Golgi apparatus in the Sporozoa agrees with that in the Metazoa in its reactions to osmic acid and resembles it in general structure and in juxta-nuclear position. During division, the Golgi elements are drawn to each nucleus in approximately equal numbers as in dictyokinesis in Metazoa. There appears therefore to be a true Golgi apparatus in the Sporozoa but there is no such certainty for the other groups. In Amœba, Brown describes globules with clear centres and dark rims which impregnate with osmic acid and may represent the Golgi apparatus, but no definite decision is expressed in the absence of silver impregnation, juxta-nuclear position or indication of dictyokinesis. Though there is evidence that in some flagellates and ciliates the parabasals and excretory apparatus show resemblances to the Golgi apparatus of Metazoa, "yet we can point to no cell inclusions which are similar in all and agree with all the criteria for the metazoan Golgi bodies. Possibly in some cases, e.g. *Opalina*, the Golgi apparatus is in a somewhat elementary condition, and the parabasal apparatus may also represent a not wholly differentiated Golgi apparatus."

Fungi causing Human Blastomycosis. A very interesting paper entitled "Observations on Fungi isolated from Cases of Blastomycosis cutis and Blastomycosis pulmonalis in North America and Europe. Remarks on Blastomycetin" appears in the *Journal of Tropical Medicine and Hygiene* of October 16. The authors are Sir Aldo Castellani and Prof. Igino Jacono, who publish photographs to show the almost terrifying severity of blastomycetic ulcers upon the human skin. The fungi which cause the diseases have been studied with a detail worthy of Sir Aldo Castellani's great resources. The present paper describes the cultural and microscopical characters of the organisms, but further work on inoculation is also in progress. Representatives of the genera *Torulopsis*, *Monosporium*, *Glenospora*, *Geotrichum*, *Phialophora*, *Acrotheca et al.* have been studied, and most of the species have been described for the first time. Tests have been made with monovalent and polyvalent blastomycetin, in order to see if it has any value for diagnosis.

Absorption of Calcium by *Terminalia glabra*, W. and A. Mr. B. L. T. de Silva, of the Department of Botany, University College, Colombo, in a communication to the Editor, directs attention to the remarkable manner in which *Terminalia glabra*, W. and A., accumulates calcium from the soils of the Miocene limestone of northern Ceylon. The water is usually softer in this area from wells near these trees, and the villagers in the dry zone burn the bark of the tree as a source of lime. In this region the ash of the leaf was 57–61 per cent CaO, of the bark 83–91 per cent. *Terminalia glabra* is a deep rooted tree and may thus remove calcium from the deeper layers of soils whilst its leaves, rotting in the surface layer, may make this layer richer in lime than the leached surface soil out of the range of these falling leaves. Mr. de Silva cites figures of analyses of surface soils in support of this conclusion.

New Zealand Beech Timbers. Mr. Parkham, of the Cawthron Institute, Nelson, has published an interesting paper entitled "New Zealand Beech Timbers: Their Structure and Identification" (*New Zealand J. Sci. Tech.*, 14, No. 4, pp. 233–40; 1933). Beech forests are the dominant associations forming the subantarctic rain forest of New Zealand, and extend from the East Cape district, in the North

Island, down the mountain chains to Cook Strait, and so, too, in the South Island to Foveaux Strait The object of the author's research is to describe the anatomical structure of the secondary wood in order to facilitate the identification of timbers after conversion The species included in the scope of the present report are *Nothofagus Menziesii*, *N Fusca*, *N. truncata*, *N cliffortioides* and *N Solandri* The paper contains interesting data concerning the reactions of these beeches during seasoning, their supply, and a variety of commercial purposes for which they are suited The author points out that there is a great tendency to warping, which is less marked in the silver beech (*N. Menziesii*) For some years silver beech timber has been exploited to a considerable extent locally, the annual production being about 8,000,000 superficial foot It is used mainly for general building and constructional purposes, for box-making (butter boxes and cheese crates), for cooperage, farm implements, vehicle body-building, furniture, interior finishing and fixtures, and for turnery (Ward, 1929) The author comments on the fact that up to the present very little research has been carried out on these lines, Engler (1899), Solereder (1908) and Garrett (1924) being the only authorities who have published works dealing with this subject Mr Parkham stresses the importance of maintaining the large areas of beech forest which at present exist in New Zealand, both because of the necessity of perpetuating a forest covering on the water-sheds of the many rivers and streams, and also because of the potential commercial value of such areas (see NATURE, 131, 787, June 3, 1933).

Geology of the Society Islands. Bulletin 105 of the Bernice P Bishop Museum (1933) is devoted to a report on the geology of Tahiti, Moorea and Maiao by Howel Williams, who paid a two months' visit to the Society Islands five years ago The group presents an evolutionary series where volcanic cones may be studied in all stages of erosion and where the encircling reefs are revealed in all stages of development A valuable summary is given, supplemented by many original observations, of the geomorphology and petrology of the Islands Discussing the recent movements of the South Sea islands, the author presents evidence that the Pacific floor of this region has been stable for a prolonged period Maximum proved uplifts are 250 ft. for the Marquesas, 800 ft for the Austral Islands, 230 ft. for the Tuamotus and 554 ft for the Cook Islands, there is no indication of uplift for the Society Islands, save the relative change due to the recent fall in ocean level The supposed evidences of submergence based on a study of drowned valleys are regarded as invalid, the effects of a rise of ocean-level following its fall during the glacial period being regarded as providing an adequate explanation Local tilting is no more than is to be expected in islands of volcanic origin. The report is a well-illustrated and fully documented account of a group of islands that still offers a host of problems of fascinating interest

Water-logging the Punjab. The problem of water-logging due to the general rise of the water-table over a large area is discussed by Dr. E McKenzie Taylor and others in "An Investigation of the Rise of Water-Table in the Upper Chenab Canal Area, Punjab" (Research Publication, vol. 1, No. 4, Punjab Irrigation Research Institute). Statistical examination of the figures for well levels, rainfall and irrigation discharge show a high correlation between rise of water-table and monsoon rainfall, but no correlation between rise of water-table and the amount of irrigation water supplied. The rise of water-table and the increase of irrigation are mutually exclusive. Dr. Taylor concludes that the rise of water-table can be controlled by the rapid surface removal of monsoon rainfall and recommends for this purpose the construction of storm-drains Since these deal with surface water they need be of no great depths and would be cheap to construct and maintain Deep seepage drains in the subsoil would also be of use, but would prove costly and do not appear to be a practical solution in an area of rising water-table which is not already water-logged In short, they are not a prevention but merely a cure. Surface drains, on the other hand, should lead to a permanent fall in water-table

Effect of Temperature on Energies of Photoelectrons. The *Physical Review* for December 1 contains two papers by Du Bridge and Hergenrother and by Roehr, on the energy distribution of photoelectrons from molybdenum at different temperatures. In the former paper, the normal component of the velocity of emission was studied by applying a retarding potential between a flat emitter and a parallel plate electrode, in the latter paper the total energy distribution was studied by placing the emitter at the centre of a spherical collecting electrode The emitter was heated by an intermittent current and arrangements were made so that the photocurrent was collected with the heating current off The results were analysed in the light of the theoretical work of Du Bridge based on a Fermi-Dirac distribution of the velocities of the electrons The fit obtained between theoretical and experimental curves was satisfactory The accuracy of the classical determination of h by the application of Einstein's photoelectric equation is brought into question, since these determinations involve an extrapolation of the tail of the photocurrent–retarding potential curve, which is now shown to depend on temperature It appears, however, that the shape of the curve is such that simple extrapolation yields results which all differ by the same amount from the theoretical values at absolute zero of temperature, and the photoelectric determinations of h are probably unaffected by the temperature effect.

Sulphides of Zirconium. The information on the sulphides of zirconium was in an unsatisfactory state and the preparation of three definite compounds, ZrS_2, Zr_2S_3 and Zr_4S_3, by Pichon (*Bull. Soc. Chim*, 53–54, 1269, 1933) has confirmed the existence of the first compound and added two new sulphides to the group The method of preparation was to act on zirconium oxide at a high temperature with hydrogen sulphide. By heating first at 1100°–1200° and then raising the temperature to 1700°, a fused crystalline mass of Zr_2S_3 is obtained. On heating this at 900°–1300° in hydrogen sulphide, the black disulphide ZrS_2 is produced; and Zr_2S_3 on heating at 1400° for two hours in a cathode ray vacuum, or in hydrogen for one hour at 1700°, yields the brown Zr_4S_3 All the products are crystalline. Evidence of the existence of Zr_3S_4 was also obtained. The chemical properties of the substances were examined and it was found that the action on numerous reagents was less pronounced with the compounds containing less sulphur

Auroras, Electric Echoes, Magnetic Storms

By SIR JOSEPH LARMOR, F.R.S.

RECENT reports by E. V. Appleton and his associates, Norwegian and other[1], have brought out the complex connexions between the optical and magnetic phenomena of the upper atmosphere. The considerations that follow touch only the fringe of this interesting subject: but it may be permitted to record them before they pass out of memory.

Assuming waves short enough to permit analysis by ray-propagation, there would be two paths of transit from one place to another not too distant, one straight across, the other by reflection from what has been appropriately termed a ceiling aloft This latter is represented by a caustic surface, belonging to the source supposed of coherent periodicity, at which all the rays are turned back tangentially none can get across it, unless the medium is discontinuous consisting for example of banks of reflecting ionic clouds. Some frequencies have no ceiling, or one only of limited extent. The numerical densities (N) of electrons at the apices of the ray paths, which practically lie along the caustic, are determined at once by the optical law of refraction, that $\mu \sin z$ is constant along a ray; for the directional angle z to the zenith is $\frac{1}{2}\pi$ at the apex, so that the value of μ there is $\mu_0 \sin z_0$ for the position of the observer Unless the direction of emission is at very small angle (z_0), μ is thus a moderate fraction of the initial value μ_0, about unity, at the level of emission Either then N at the apex is a moderate number, rather less than for vertical reflection as *infra*, or else z_0 is very small so that all the rays that reach the ceiling start off nearly vertically and bend sharply, or else the analysis by rays is not applicable to the lengths of waves concerned.

It has been found, without doubt, that rays are returned straight back along the vertical path, the highest point of the gradually sloping caustic surface being as above overhead Its exact position can scarcely be determined: but certainly the plane for which μ vanishes—the velocity of propagation there becoming infinite or the medium optically rigid—which is readily estimated, lies beyond the caustic The familiar formula for frequency $p/2\pi$ and electrons of mass m,

$$\mu^2 = \mu_0 - \frac{4\pi N e^2 c^2}{mp^2}, \quad \frac{p}{c} = \frac{2\pi}{\lambda}, \quad \frac{e}{m} = \frac{7}{4}\cdot 10^7, \quad e = \frac{3}{2}\cdot 10^{-20},$$

gives, for N per cubic cm. and λ in cm, $\mu^2 = 1 - \frac{5}{6}10^7 N\lambda^2$ Thus for waves of the order of 300 metres, μ^2 would vanish when N has risen to the moderate value $\frac{1}{7}10^5$, and for 30 metres to $\frac{1}{7}10^7$ The intensity of ionisation which thus arrests propagation by waves is small, perhaps much beyond expectation. This does not, however, mean that a cloud of ions, of diameter more than a few wave-lengths, would collapse by any essential instability. Vanishing index means that the medium is electrically absolutely rigid for these lengths of waves, so that disturbances of such length could not get into it at all, would be turned back or in part smothered: infinite index, as *infra*, would mean that it is flaccid, with like results: this now holding good whether treatment by rays is applicable or not, thus in this rough estimate avoiding the complexities of gyro-radiational analysis, as exemplified in S. Goldstein's work[2]. If radiation of various wave-lengths is sent up from the source, each constituent is turned back before the stratum for which N has the limiting value (inversely as λ^2) is reached. This is the foundation on which is based the exploration of atmospheric strata by vertical radiation, as initiated and extensively carried out by Appleton and his colleagues, uncertainties regarding oblique reflections thus not entering into the estimates.

Carrying the analysis further in a magnetic field H_0, in the simplest case for the two cyclic waves ($+H_0$ and $-H_0$) travelling directly along H_0, the expression for μ^2 involves in the denominator $mp^2 + eH_0p$ instead of mp^2 One of the two waves becomes obliterated by μ^2 trending to infinite value, so that the velocity fades to nothing at a stratum where p or $2\pi c/\lambda$ has fallen to $\frac{7}{4}\,10^7\,H_0$, which for values of H_0 of the order of the earth's magnetic field would be when λ is more than half a kilometre The radiation which gets through is then solely the conjugate cyclic component Here N does not occur at all in this estimate but that could not mean that even a very sparse distribution of electrons would prohibit one set of component waves if the impressed field H_0 (or rather $H_0\lambda$) were great enough. It means that there could not be cyclic radiation of this kind with what few electrons there may be present playing a part in it; this is because in circular orbits such as they would have to follow the centrifugal reaction mp^2r could not adapt itself to compensate the electrodynamic force eH_0r, and therefore such participating orbits could not subsist · but when the number of ions is small cyclic radiation can travel in the ordinary manner, only slightly disturbed by their irregular motions

Specially close connexion of magnetic storms and the Aurora Polaris with anomalies in wireless radiation is reported by Appleton. This contrasts, of course, with the extremely subordinate influence of magnetic fields on the short waves of physical optics, except for ferromagnetic metals. A conceivable presumption would be that the aurora is due to lasting local pulsations on a large scale, so of long period, excited somehow by a local cause large enough and of abrupt type, produced conceivably by arrest high up of an ionised torrent from outside sufficiently concentrated to require relief by propagation in waves the incidence of such long undulations on the molecules of the lower rarified atmosphere could produce the light of the banded auroral curtains. As these bands lie along the direction of the magnetic field this would imply facility of spiralling transmission along that direction. Probably also it has been already explored whether the auroral light shows traces of circular polarity.

Long ago the ascription of terrestrial magnetic changes to electric currents circulating in the upper atmosphere was in favour[3], until the recognition that all currents are made up of convections of ions disturbed that view by the high electron densities implied Yet there seems no help for it if atmospheric ionic views are to be persevered with: thus in recent careful discussion, S. Chapman[4] has not been deterred from densities even up to 10^{10} electrons per cubic centimetre in positions very far up in the abnormal atmosphere. The superior mobility of the negative electrons is there the dominating influence, for compensating positive must be present.

An arresting feature of Prof. Appleton's pairs of fragmentary graphs, giving heights of reflection in terms of frequency, as directly observed, such as may be on his view connected with the two cyclic components into which the radiation is split by the earth's magnetic field, is that though of irregular form, they show rather close repetition of features, differing mainly by a shift along the axis of frequency This suggests search for an analytical correspondence between them, which it is not hard to pursue for the simplest illustrative case of radiation along the direction of the magnetic field H_0 The co-ordinates of the graphs are p, giving the frequency $p/2\pi$ of the waves, and the altitude z of the reflecting layer estimated by the rough criterion of vanishing index μ. More generally, N being some assigned function of z, the graph may relate to any constant value of μ or c/c' The equation of propagation (cf my "Math and Phys Papers", vol 2, p 651, as alone here accessible) is, if φ denotes the single complex electric variable $P + \iota Q$ and d/dt is ιp,

$$-\frac{d^2\varphi}{dz^2} = Kc^{-2}p^2\varphi + \frac{4\pi cNp^2}{mp^2 - 4\pi cH_0 p}\varphi$$

This type of differential equation is familiar for other modes of waves, and has been tractable for some special forms of N as expressed in terms of z When, however, N changes not too rapidly with z, a simple harmonic type $e^{\iota pt - \iota nz}$, so that $d^2\varphi/dz^2$ is $-(\mu/c)^2\varphi$, is a first approximation and, φ dividing out, gives μ^2 in terms of p and N Transition is made to the conjugate wave train by change of sign of H_0 To explore correspondence of the types indicated, we restrict to the case of μ nearly vanishing, when

$$N = \frac{Km}{4\pi ec^2}\left\{(p + p_0)^2 - p_0^2\right\},$$

where p_0 is $2\pi cH_0/m$, being half the critical frequency above described Only in the circumstances of short waves is p_0^2 small compared with p^2 and roughly can be neglected then N is determined by $p + p_0$, and the graph for (N,p) is merely displaced opposite ways from a central position by adding $+p_0$ or $-p_0$ to the abscissa p according to the sign H_0. But the actual graphs belong to long waves

In the next simplest case, when the magnetic field H_0 is transverse to the waves (*loc cit*, vol 2, p 655, where some misprints are to be set right), the displacement of the graphs now involving $(p_0/p)^2$, would be large for a magnetic long wave (The condition for μ to vanish then takes a simple form $Lp = \pm N$) The actual case, that of field oblique, along the line of magnetic dip, would be nearer the former though intricate, it may possibly be worth the trouble of exploring, if that has not already been done by Goldstein (*loc cit*) Down to the higher atmospheric density of the auroral levels the incident electron streams could scarcely penetrate.

As Appleton originally suggested, and is confirmed by Ratcliffe's records, the upper reflection is probably due to an independent layer, and both reflections can be split by the magnetic field in a manner to which this analysis applies

By good fortune, however, the magnetic complications here described appear largely to compensate themselves A cyclic wave-train of dextral chirality going up would be returned as a train of the same chirality, in absence of a magnetic field. imposing the earth's magnetic field would affect them in opposite ways: thus so far, if there is no error here, the magnetic delays in ascent and return should cancel, provided they are along the same path, so that there would be no delay on this ground in reception between the two cyclic components of a wave-train the actual delay would arise from their reflection being at different levels, and would afford a measure of the interval, and thence of the difference in electron density The conjugate cyclic polarisations, each *received* reversed, would remain as a test whether the splitting of the beam is of magnetic type

A reflecting layer would have to be fully established in a fraction of a wave-length, thus rather abruptly for short waves. Thus it would have to fade away more gradually above to avoid thin-plate phenomena: this and the much larger density N that must be attained notwithstanding for short waves may provide clues for exploration

The unexpected result, that whether a magnetic field be present or not, a quite small density of ions entirely upsets the optical elasticity of space as regards long waves, provides a cause preserving ionised gaseous clouds of astronomical size, for example in the interiors of stars, from rapid dissipation or dispersal in bulk; in fact saves an ionised region from lapse to uniformity by internal radiation.

The description[2] of a recording apparatus developed by J A Ratcliffe and E L C White has just attracted my notice The automatic photographic records, of which examples are printed, convey a sense of actuality to which mere verbal description could scarcely attain The continuous run shows the intervals of time during which double reflections are present, and the heights, sometimes very great, from which they appear to arrive We may thus know in time as much about the earth's upper atmosphere as we seem to know about that of the sun The abrupt changes in vertical atmospheric structure recorded in crossing sunset and sunrise meridians agree closely with the early suspected cause of the related disturbances in long-distance signalling

As regards the rather uncertain concept of group-velocity (cf *loc cit*, vol 2, p 546), so familiar for a long time in hydrodynamics, it is an affair, as Hamilton first described it, of an *unlimited* train of regular waves with humps of increased amplitude at intervals, which travel through the waves with a velocity of their own, dp/dn as against p/n for the basic waves These humps do not constitute a train of waves of the same type, for their average amplitude would be null, though they could be receivable as in wireless practice by different apparatus It may not be too wild to imagine a permanent train of waves sent out and encountering a dispersive region in which the group velocity approaches zero owing to very sharp curve of dispersion, so that these humps remain nearly stationary, but when the train on which they ride is terminated, they relieve themselves by propagation forward and backward. but in any case these are scarcely the circumstances of the alleged echo of long delay

V. M. Slipher reports regular occurrence of flashes of auroral spectrum at sunrise and sunset. One can conceive an upper stratum ionised by the solar radiation, and a lower by the long electric waves that can disturb electric reception

These long atmospheric waves would be indicated by disturbed electric reception, but they would not affect the magnets; that would be due to the vast exciting torrents of solar electrons flashing past the earth and partly arrested aloft. They would require a compensating fall into the sun (perhaps spiralling in the sun's rather strong magnetic field) and, as it would be at slower velocity, there would be a solar electric charge. Yet, as I understand, G E. Hale could not find any trace of Stark effect of resulting solar electric field. which would be adequately explained if the electric charge, being of course a surface sheet, lies outside the layer which emits the light The penetration of the cosmic radiation, if it carry a charge, or part of it, into the earth has been in like manner assigned as a cause maintaining the earth's electric charge[6]. by the usual estimate it would have to replenish the static charge of the earth every ten minutes The spatial density of compensating charge falling back into the sun would be considerable if it fell slowly but there is scarcely ground for connecting the fixed spectral lines of some double stars with an atmosphere of that kind. This principle of emission in one mode and compensating absorption in another, is far-reaching · thus it is the foundation of the Einstein theory of radiation by projected and absorbed 'photons'

The characteristic feature of the modern spectral theory, expressing itself in sporadic transitions between energy levels, is that, while it aims at inclusion of the Hamiltonian dynamical analysis, each line has its own configuration of the source, without any overtones such as were a necessary part of a vibrational theory. The equation of Hamilton-Jacobi and the related one of Schrödinger would belong not to an atom but to a cosmos, thus coming into line towards the various universal modes of statistics In asymptotic limit[7] (λ large) the two schemes, Hamilton's (generalised) rays and Schrödinger's potential, come into agreement

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[1] NATURE 132, 340, Sept 2, 1933

[2] *Proc Roy Soc*, 1928

[3] cf *Phil Mag*, Jan 1884, 'Math and Phys Papers," vol 1, p 28

[4] *Terrestrial Magnetism*, 1931 33

[5] *Proc Phys Soc*, Feb When this was written I had not seen their records for *short waves*, and their cyclicity in the magnetic field, which is not very far from vertical, in *Phil Mag* for July Clearly there is much to be learned here

[6] cf Kolhörster, H, NATURE, 132, 407, Sept 9, 1933

[7] cf Dirac's 'Quantum Mechanics," p 121, G D Birkhoff, *Proc Nat Acad*, March 1933, p 339 also Levi Civita, *Bull Amer Math Soc*, Aug 1933 An early attempt toward such correlation is in the writer's "Papers', vol 2 (1928), p 809

Anniversary of the Asiatic Society of Bengal

ON January 15 the Asiatic Society of Bengal celebrated the 150th anniversary of its foundation by an afternoon conversazione in the Indian Museum, and a banquet in the evening followed by a special anniversary meeting The conversazione was attended by the Mayor of Calcutta and about five hundred of the leading citizens of Calcutta It took the form of a garden party on the lawn of the Museum and special and interesting collections of exhibits, consisting of paintings lent by the Academy of Fine Arts, copies of old documents from the Imperial Records Department, mostly of the eighteenth century and some concerning the Asiatic Society, paintings of plants from the Botanical Survey, Javanese and Siamese sculptures lent by Dr S K Chatterji, chemical and physical demonstrations arranged by the University College of Science and Technology, prehistoric and tenth century finds from the Archæological Survey, fossils, crystals and economic products from the Geological Survey, birds of Bengal lent by Dr S C Law, demonstrations of the prevention and treatment of disease arranged by the School of Tropical Medicine and Hygiene, medals and coins by His Majesty's Mint, Kaffir attire, fish, Crustacea and insects from the Zoological Survey

The banquet was honoured by the presence of His Excellency Sir John Anderson, Governor of Bengal, who is the patron of the Society, and took place in its one hundred and twenty-six year old hall, surrounded by portraits and busts of former members who have made history in Bengal Ninety-three members and guests were present, including the consular representatives of France, Germany, Holland, Sweden and the United States of America, the Archbishop of Calcutta, the Hon Sir M N Roy Chowdhury, Sir David Ezra, the Hon. Nawab K. G M Faroqui, Sir C. C. Ghose, the Hon Sir A K Ghuznavi, Lord Sinha, the Hon Sir B P Singh Roy, and Sir Jadu Nath Sircar The toast of the guests was proposed by the president of the Society, Dr L. L. Fermor, to which M J. Delacour, of the National Museum of Paris replied, and also proposed the Asiatic Society, but speeches were brief, in view of the meeting afterwards.

At the special anniversary meeting, His Excellency the Governor took the chair and the president delivered his anniversary address, outlining the history of the Society, and naming the distinguished contributors to its publications, more especially in the last half century He pointed out that many of the specialist departments and institutions founded in India originated from the Asiatic Society, in particular the Indian Science Congress, and mentioned the proposals which had been made for the formation of an Indian Academy of Sciences to affect co ordination between these various interests in the sphere of science

Following the president's address, congratulatory messages were read from His Excellency the Viceroy, the Mayor of Calcutta, the League of Nations, Prof C Rockwell Lanman, Sir George Grierson and Sir Thomas Holland (honorary fellows) Seven addresses were read, from the British Museum, the Linnean Society, the Zoological Society of London, the Batavian Society of Arts and Sciences, the Indian Institute, Oxford, the Schopenhauer Society, Frankfort, and the Prussian Academy of Sciences Congratulations were presented by 26 delegates from 58 learned institutions, and in all 19 countries were represented—Australia, Austria, Belgium, Ceylon, Canada, France, Federated Malay States, Germany, Great Britain, Hungary, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, Tasmania, United States and India

Twelve honorary anniversary members were elected—six in letters and six in science. Prof. Arthur Christensen of Denmark, Prof. Taha Husain of Cairo, Sir John Marshall, lately Director-General of Archæology in India, H R H Prince Damrong Rajahubhab of Siam, Dr. Rabindranath Tagore, Dr J Van Kan, law member of the Council of the Viceroy of the Dutch East Indies, Sir Sidney Burrard, lately Surveyor-General in India, Prof Albert Einstein, Sir Sven Hedin, Prof Alfred Lacroix, Dr. Henry Fairfield Osborn and Lord Rutherford.

In his speech, His Excellency the Governor stressed the vigour of the Society in spite of its age, its permanence since the days of the French Revolution, and the esteem in which it is held abroad, as manifested by the spontaneous tributes received from all over the world. He directed attention to the traditional connexion of the ruling princes of India with the Society, and hoped that this tradition might be widened, to the benefit of scholarship, by the inclusion in the Society's list of members of the name of every substantial ruler in the country.

His Excellency paid special tribute to three members of the Society, Sir Rajendranath Mookerjee, Mr. John Van Manen (general secretary) and Dr. S. L. Hora (honorary secretary of the Celebration Committee).

Research in the British Post Office

WHEN the State purchased the telegraphs in Great Britain in 1869, the number of electrical workers in the whole country could almost be counted on the fingers. To-day the engineer-in-chief of the Post Office controls a staff of about 30,000 and maintains plant of a value of 130 million pounds. Starting from the needle instruments, skilled Post Office experimentalists developed the Wheatstone transmitter and receiver; instruments capable of operating up to 300 words per minute.

Capt. B. S. Cohen, the engineer of the Post Office Research Station at Dollis Hill, in a paper read to the Institution of Electrical Engineers on February 1, said that these instruments still stand unsurpassed to-day in their design, workmanship and performance. It was not until 1912 that a research section was established. During the War period, the thermionic valve was perfected and at one stroke opened a boundless vista of possibilities in the way of universal telephone communication. The paramount necessity was to obtain the closest co-ordination between the research and the operating organisations. Without full access for research purposes to the working telegraph and telephone plant, the work of the research engineers would have been immensely increased. The Research Station at Dollis Hill was started in 1921 by using ex-army huts, and the permanent buildings were completed last year. Much excellent work has been done at this station which could not have been done elsewhere.

To the research workers at Dollis Hill the increase in the volume and weight of road traffic brought with it a new problem. There are apparently under the streets an ever-increasing number of cracked gas mains. Modern road surfaces make it difficult for this gas to escape into the open and so it sometimes accumulates in Post Office cable ducts and manholes, involving a serious hazard. The research engineers have developed a simple form of gas detector for general issue to Post Office workmen. The detector operates in a way somewhat similar to a photographic exposure meter. It utilises a filter paper moistened with a few drops of palladium chloride solution and will indicate the presence of 0·05 per cent of carbon monoxide, the dangerous constituent of coal gas.

The capital value of automatic switching apparatus installed in exchanges is now very large, and great precautions against corrosion have to be taken. Sir Robert Hadfield has said that the corrosion of iron and steel alone costs the world 700 million pounds per annum. Experiment shows that the life of galvanised iron stay wire is proportional to the thickness of the galvanising. In some parts of south Lancashire, the normal life of a stay wire is little more than two years. It is now possible to estimate the life of any particular grade of wire in a given area.

In long telephone lines the 'echo' used to be very troublesome but the engineers have invented, using valves only, a very efficient echo-suppressor. A non-reflecting room at the Station has linings of cotton-wool one foot thick. This room has a totally silent background of noise. It is especially useful for listening tests where the threshold of hearing has to be found.

University and Educational Intelligence

CAMBRIDGE.—At St. John's College, one Strathcona research studentship of the annual value of £150 and two Strathcona exhibitions of the annual value of £40 are offered for competition amongst research students who are graduates of any university other than Cambridge. The election of a candidate not yet a member of the College is subject to his being accepted by the University as a research student proceeding to the Ph.D. degree and to his commencing residence in October 1934. Candidates must make application to the Senior Tutor, St. John's College, not later than July 1.

LONDON.—Dr. G. P. Wright has been appointed as from March 1 Sir William Dunn professor of pathology tenable at Guy's Hospital Medical School. Since 1931, Dr. Wright has been assistant lecturer in morbid anatomy and curator of the Museum at University College Hospital Medical School and also pathologist to the Hospital.

It is expected that the new British Postgraduate Medical School at Hammersmith will be opened to students in October next. It has been given recognition as a School of the University for a period of two years, as a temporary measure.

OXFORD.—In presenting Miss Ethel Bellamy for the honorary degree of M.A. on January 30, the Public Orator, Mr. C. Bailey, took occasion to remind Convocation of the distinguished services rendered by that lady and other members of her family in the cause of astronomy, and particularly in the important part taken by the Oxford Observatory in the photographic survey of the heavens. In consideration of the recent help accorded to the Vatican Observatory towards the completion of that work, the Pope has bestowed on Miss Bellamy a decoration of silver.

ST. ANDREWS.—The Court has agreed to institute a lectureship in bacteriology in the University and has appointed Mr. James F. Murray, who has hitherto been assistant to the professor of bacteriology, to the lectureship as from February 1; Mr. A. B. Stewart has been appointed to succeed Mr. Murray as assistant in the Department.

THE booklet on the new buildings of the University of London, edited by T. Ll. Humberstone and published by the Dryden Press (see NATURE, June 24, 1933, p. 903) has been withdrawn from publication and replaced by a similar book containing also a report of the stone-laying ceremony by the King on June 26. This is published by Mr. William Rice, 3 Ludgate Broadway, E.C.4, at 2*s.* 6*d.*

Science News a Century Ago

Ericsson's Caloric Engine

In 1833 John Ericsson, the famous Swedish engineer, patented a form of hot air engine and his invention formed the subject of a lecture by Faraday on February 14, 1834, at the Royal Institution Referring to this lecture, the *Mechanic's Magazine* said that "after the very favourable opinion we expressed of this invention it gave us no ordinary pleasure to hear it so well spoken of by so eminent authority, in all matters of science, as Dr Faraday He pronounced the theory on which the engine was constructed to be philosophically correct, and the arrangements for turning it to a practical account to be at once novel and ingenious, but expressed some doubts as to whether sufficient provision had been made for preserving that regular alternation of pressure which is necessary to keep the pistons in motion" In Church's "Life of John Ericsson", (vol 1, p 75) it is said "Just as Faraday was preparing to appear upon the platform he came to the conclusion that he had made a mistake as to the principle of the expansion of air upon which the action of the machine depended He accordingly commenced his lecture, greatly to the disappointment of Ericsson, by the announcement that he was unable to explain why the engine worked at all" According to the *Mechanic's Magazine*, Ericsson was not at the lecture owing to illness

Great Lenses in One Piece

"At the meeting [on February 14] of the Royal Society of Edinburgh . . three splendid polyzonal lenses were exhibited by permission of the Commissioners of the Northern Lighthouses One of these was made in Paris, another in London, and the third in Newcastle The diameter of the outer zone of two of these lenses is 2 feet 6 inches, and that of the London instrument is three feet Their focal distance is about three feet. At the desire of Mr Robinson, the Secretary, a single argand burner was placed in the focus of one of the lenses, but the effect was feeble, as this instrument requires a powerful light By exposing it to the rays of the sun it suddenly melts pieces of copper and other metals placed in its focus The Newcastle lens is made of one piece of highly polished glass Buffon, nearly a century ago, first suggested the idea of a polygonal burning glass, but the construction of this instrument has till now been considered beyond the skill of the artist, and the method of building them in separate pieces was afterwards suggested and practised . . in this country and in France. Messrs Corkton, however, the plate glass makers of Newcastle, at length triumphed over the difficulties which so long retarded the execution of Buffon's project. These lenses are about to be removed to Gulland Hill, where their effect will be fully tried, along with the light invented by Lieut. Drummond, from the experiment rooms of the Northern Lighthouse Board" ("Annual Register", 1834)

Liverpool and Manchester Railway

In the *Mechanic's Magazine* of February 15, 1834, is an article on the half-yearly report of the Liverpool and Manchester Railway, for July–December 1833. There had been a very considerable increase in traffic and a dividend of 9 per cent had been declared The total number of passengers booked had been 215,071 and the total quantity of goods carried 98,247 tons, beside 40,134 tons of coal The number of trips of 30 miles performed by locomotives with passengers had been 3,253 and with merchandise 2,587 The figures showed an increase in the number of passengers of 32,248 and an increase in the weight of goods of 11,405 tons The winter had been very wet and stormy, there had been great difficulty in keeping the railway in good order and the boisterous weather and the dirty state of the rails had impeded the passage of the trains; "assistant engines had frequently been required to ensure their progress even on the level parts of the way" Among other items mentioned was that gas coke was being tried in the engines in the place of Worsley coke at a cost per ton of less than a half.

Death of Lionel Lukin

On February 16, 1834, Lionel Lukin, one of the pioneers of the lifeboat, died at Hythe, Kent, at the age of ninety-one years Born at Dunmow, Essex, on May 18, 1742, Lukin became a London coachbuilder having premises in Long Acre, where he continued in business until more than eighty years of age Fertile in invention and with scientific leanings, he invented an adjustable bed for invalids, a raft for rescuing persons from under ice and a rain gauge For a long period he kept a daily meteorological record His experiments with boats were begun in 1784, when he altered a Norway yawl and tested it on the Thames The following year he obtained a patent for his "unsubmersible boat". His claims included a method of construction for either sailing or rowing boats which would neither upset in violent gales nor sink if accidentally filled with water He proposed to fit projecting gunwales, either hollow or filled with cork, together with watertight compartments at the stem and stern and under the seats, which would contain air or cork. His invention was submitted to many distinguished men and was tried at Ramsgate and Margate He had, however, to contend with seafaring prejudices and his boats were in little request A description of them was published by him in 1790 Lukin's invention was almost contemporary with that of the Shields boat-builder, Henry Greathead (1757-1816), through whose work lifeboats were introduced in the north of England

Royal Society Fellowship, 1834

One hundred years ago there was practically no restriction as regards the number of fellows that might be elected in the course of the regular meetings of the Royal Society A statute, enacted in 1831, provided that no election for fellows or for foreign members should take place excepting on the first ordinary meetings of the Society in December, February, April and June. This remained in force until 1835, when it was repealed In 1847 the plan of electing fifteen fellows annually became the rule, and in 1930 the number was increased to seventeen The following were elected in February 1834. Capt Francis R. Chesney, Thomas Copeland, Sir Edward Cust, James Horne, John Russell Reeves, Lieut.-Col. William H. Sykes, John Waterhouse No foreign members were elected during the year 1834.

The custom of holding no meeting on the anniversary of the death of Charles I lapsed after January 30, 1834.

Societies and Academies

London

Royal Society, February 1 A K Denisoff and O W Richardson The emission of electrons under the influence of chemical action This paper starts by summarising some general conclusions reached from experiments on the reaction between K_2Na and 22 different gases A more refined and detailed experimental investigation than has hitherto been carried out with phosgene is then given This is followed by a discussion of the low energy part of the spectrum, the determination of the true zero on the volt scale and of E_m (maximum energy found from the energy distribution curves) and its relation to E_c (energy of corresponding elementary chemical reaction responsible for E_m) The last section confirms the equation $E_m = E_c - \varphi$ (work function of the metal) for the particular case of $COCl_2$ Sir Robert Robertson, J J Fox and A E Martin Two types of diamond From an observation that a diamond failed to give a prominent absorption band at 8μ in the infra-red region of the spectrum where a great number of diamonds gave this, a similar exploration was undertaken in the ultra violet region, where a difference in absorption in the same sense was found More examples were found and two types were recognised, the more common or opaque Type 1 (band at 8μ and complete absorption at λ 3,000), and Type 2 (no band at 8μ and complete absorption at λ 2,250) Other properties were investigated Type 2 was found to be more isotropic optically than Type 1, but there was no difference in specific gravity, refractive index and dielectric constant between the types , or in the Raman effect, which gave one fundamental frequency at 1,332 cm^{-1} for both types From the complete band system in the infra-red (to 17μ) and the new carbon bands found about λ 3,000 in the ultra-violet, together with the Raman frequency, a picture is sketched of the various modes of vibration of carbon against carbon in the diamond structure, for which the frequency of the fundamental vibration is also calculated While most diamonds give some response to light when the passage of the dislodged electrons is assisted by an applied potential, some diamonds (of Type 2) generate a current without the application of any voltage When these diamonds have been activated by light of λ 2,300 they acquire a condition in which light of certain wave-lengths can quench the photo conductivity while others augment it

Paris

Academy of Sciences, December 26 (*C R* , 197, 1705–1784) The president announced the death of Charles Porcher, *Correspondant* for the Section of Rural Economy E Jouguet The theory of critical phases The generality of the properties of zero area. Charles Nicolle, Jean Laigret and Mme Hélène Sparrow Vaccination by the digestive tract in the ape against exanthematic typhus Edmond Sergent, Etienne Sergent and A Catanei "Malaria houses" and the "instinct to return to their feeding ground" in the mosquito In malarial localities, the disease appears year after year in certain houses whilst neighbouring houses escape Experiments are described which tend to prove that the mosquito has no instinct to "retour à la pâture" and hence some other explanation must be sought for malaria houses. Chadenson The extension of the Bolzano-Weierstrass theorem to certain functional ensembles. W. Sierpinski The hypothesis of the *continu* and Baire's property Th H J Lepage · Certain exterior differential forms and the variation of double integrals Tchang Te-Lou · The electric ignition sparks in internal combustion motors. Turbulence in the motor cylinder causes multiple sparks and it is inaccurate to consider the explosion as the result of a single spark There is no reason to suppose that turbulence suppresses the sparks Emile Merlin The existence of osculating orbits remaining elliptical in the problem of two bodies with decreasing mass Al Proca Solutions of the Maxwell equations for a vacuum André Guilbert The possibility of obtaining a variable yield of direct current generators the exciter of which is controlled by phenomena of transversal reaction Raymond Lautié The determination of the atomic weight of molybdenum The method chosen was the reduction of molybdic oxide to the metal by heating in hydrogen The preparation and purification of the molybdic oxide are given in detail. The value found is 96 01 ± 0 01 René Van Aubel The gold-bearing zone of the eastern Urega (Kivu, Belgian Congo) G Schneider and L Moret A new hypothesis on the origin of the thermo-mineral springs of Aix les Bains (Savoie) V Frolow Analysis of the levels of the Niger and the Nile R. Delaby, R Charonnat and M Janot The variations of a hot spring the Dames de Plombières spring Study of variations in radioactivity (water and evolved gases), temperature and total solids The radioactivity showed the most marked variations A Dauvillier Cosmic activity and solar activity Observation of the cosmic rays at Scoresby Sound during the Polar Year The experimental results are discussed from the point of view of the author's theory of the origin of the cosmic rays (*C R* , 193, 348) Ph Joyet-Lavergne The diagnosis of sex through the characters of sexualisation W Besnard and P J Korda The action of luminous and ultra violet radiations emitted by special lamps on the growth and reproduction of some aquatic plants Studies on the best type of lighting for maintaining the life of plants Robert Garnier and Sébastien Sabetay The analytical constants of Bulgarian attar of roses E Miège and M Simonet The caryological study of the *durum* types appearing in the cross *Triticum vulgare* var *alborubrum* with *T vulgare* var *oasicolum*. S Nicolau, P. Poincloux, L Kopciowska and G Balmus The morphological study of the peripheral blood in the experimentally poisoned rabbit megamononucleosis Raymond Jacquot Is cow's milk an equilibriated food for all mammals ? Cow's milk is a food best utilised in the larger animals It produces growth in certain mammals (calf, pig), keeps others in good condition (rat), but with the hedgehog, although the milk is easily digested, it is badly utilised and the animals die of protein starvation A Trillat . Experiments in anaphylaxy produced by air infection. A and R. Sartory, J Meyer and Ernst The inhibiting influence of radium on growth of the rootlets of *Lens esculenta* the minimum preventive dose and time of irradiation G Viaud · Phototropism of *Daphnia* Laws of the positive tropistic movement Ph L'Héritier and Georges Teissier The study of a population of *Drosophila* in equilibrium Paul Wintrebert The intervention of the egg in the deposit and constitution of the tube envelopes in amphibians (*Discoglossus pictus*).

N Kobozieff : The genotypical constitution of mice with normal tails born of parents without tails or with short tails. D. Bach and D Desbordes The paradoxical action of the mycelium of *Aspergillus repens* on ammonium nitrate Increase of the medium in ammonia. N. Bezssonoff and A Delire . The identification of vitamin C and of its derivatives present in biological media E Brumpt · Experimental researches on myiasis in batrachians, produced by the fly *Lucilia bufonivora* F Vlès and A. de Coulon Therapeutic attempts with amino-acids to produce spontaneous cancer in mice André Kling Contribution to the study of the chemical processes intervening in the production of acute œdema of the lung after contact with certain corrosive gases.

LENINGRAD

Academy of Sciences (*C R*, N S, No 2, 1933) B Segal A theorem analogous to Waring's theorem Every integer from a certain point onwards is the sum of $2(n^2 2^n - 1)$ or less terms of the form $[x^c]$, where x is integral. D Ivanenko Constituent parts of atomic nuclei. If the conception of a proton consisting of neutron and positron is accepted, this leads to the conclusion that the neutron is equal to a proton plus an electron This does not require an assumption of the complexity of heavy particles, at least not in the sense of macroscopic mechanics On the contrary, both particles are considered as different quantum states of a single primary particle It is assumed that both protons and neutrons are stable M Romanova and A. Ferchmin The hyperfine structure of the red line of cadmium (6438), and the green yellow (5649) and green (5562) lines of krypton Two intense satellites (– 0 0034 A and + 0 0035 A) and a diffused weak line (+ 0 0092 A) were found in the red line of cadmium For the green line of krypton five strong satellites and four weak ones were observed, and for the yellow green line of krypton there are four strong satellites and three weak ones. N Zelinskij and N I Shuikin · Hydration of the furan nucleus by catalytic osmium By passing sylvan (α-methylfuran) at 80°–82° C. over the osmium deposited on asbestos, the authors obtained the tetrahydrosylvan, not differing from that synthetically prepared by Lipp A Grunberg, A Filippov and I Jasvonskij The occurrence of gallium in the sulphide ores of Ridder in the Altai The gallium was found mainly in the zinc-blende A method is offered for separating gallium from the ore A A. Richter, V Rancan and M Pekker Control of "yarovisation" With the view of working out the external diagnostic methods for registering the changes in the internal state of the yarovised seed, the authors studied the enzymotic indices, the indices of the respiratory process, of the concentration of hydrogen ion and of the deficiency of buffer capacity, as well as the absorption of dyestuffs by the albumino-lipoid complex of cells in connexion with the yarovisation. V Novikov, A Gretchushnikov, J. Barmenkov and A Nosov The process of assimilation and formation of cautchouc in tau-sagiz. The conditions most favourable for a maximum rate of assimilation and for the formation of cautchouc are bright sunny days and a soil humidity of 60 per cent of the full capacity, which assures a water content in leaves not lower than 77 per cent A Taranec · Some new freshwater fishes from the Russian Far East. Descriptions of two new subspecies and a new species of the genus *Salvelinus*, a key to the Pacific species of the genus, a description of *Cottus mimetus volki*, sb-sp.n. and notes on *Aboma lactipes*, Hilg and *Chloea castanea*, O Shang are given. S Heller and V Kunin . Origin of ridges of sand Fixed ridges of sand such as observed, for example, in some parts of the Baltic littoral, on the east side of Lake Chad, in the Karakum desert, and on the right bank of the Nile in Egypt must be regarded as a result of the activity of flowing water

ROME

Royal National Academy of the Lincei, communications received during the vacation E Almansi Deformations of elastic strips (8) U Broggi An application of Newton's series Margherita Piazzolla Beloch Solution of a problem of aero photogrammetry I Opatowski Biharmonic functions as products analogous to Lamé's products, and lines of force of Newtonian fields (2) F Tricomi Further reference to a note on Integration of a differential equation encountered in electro-technics Reply is made to criticisms of the author's earlier paper on this question J C Vignaux A generalisation of the summation of Le Roy's divergent series C Dei Sensitiveness and accuracy of the measurement of the internal resistance of triodes The three methods of Miller, Appleton and Lo Surdo are discussed separately A Baroni Lithium alloys (2) X-ray analysis of the system lithium-cadmium Thermal analysis of this system substantially confirms Grube, Vosskuhler and Vogt's results (1932) but not those of Tammann (1910) X ray analysis allows of the identification of (1) the compound Li–Cd which exhibits monometric structure of the CsCl type and with the value 3 32 A for the side of the unit cell, and (2) the compound $LiCd_3$, which is probably also monometric, with the unit cell side 8 62 A and with eight molecules in the cell X-ray analysis does not, however, indicate the compound Li_3Cd found in thermal analysis A Ferrari and C Colla Rhodionitrites of ammonium, potassium, rubidium, cæsium, thallium, barium and lead The crystal structure of these compounds is of the potassium cobaltinitrite type and the side of the unit cell has the values (all ± 0 02) 10 91, 10 63, 10 83, 11 30 and 10 91 A respectively, for the corresponding cobaltinitrites the values are 10 81, 10 44, 10 73, 11 15 and 10 72 A Barium and lead rhodionitrites prove to be anhydrous, the water they retain at moderately high temperatures being wholly zeolitic in character, the unit cells are cubic (possibly pseudo-cubic) and the values of the side are 10 70 A and 10 53 A respectively These compounds are isomorphous with those of the univalent metals, the anions occupy the same positions in the two classes of lattice, but with the bivalent metal compounds the cations occupy only one half of the number of positions occupied in the other case P Pratesi Condensation products of isatin with pyrroles (pyrrole blue) (2) R Redini Geology of Monte Pisano and the Apuan Alps S. Sorrentino . Cenomanian outcrop in the high valley of the river Salso V. Famiani Food value of germinating grain In experiments on growing albino rats, germinating grain showed a nutritive value superior to that of dormant grain M Calcinai Hæmatic modification of inflammation. In experiments with rats, it was found that endoperitoneal injection of lactic acid (as sodium salt) modifies and accentuates the local inflammation produced by croton oil

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, February 12

ROYAL GEOGRAPHICAL SOCIETY, at 5—Dr R Greene "The Food and Health of the Mount Everest Expedition"

UNIVERSITY COLLEGE, LONDON, at 5—Dr. H R Ing "Chemical Structure and Pharmacological Action" (succeeding lectures on February 19, 26, March 5, 12 and 19) *

UNIVERSITY COLLEGE, LONDON, at 5 30—A M Hocart "The South Seas, the Organization of the People" *

NEWCASTLE-UPON-TYNE ASTRONOMICAL SOCIETY AND UNIVERSITY OF DURHAM PHILOSOPHICAL SOCIETY, at 7—(at Armstrong College, Newcastle)—Abbé G Lemaître "Evolution in the Expanding Universe" *

ROYAL SOCIETY OF ARTS, at 8—Sir Robert Davis "Deep Diving and Under Water Rescue Work" (Thomas Gray Lectures Succeeding lectures on February 19 and 26)

Tuesday, February 13

ROYAL COLLEGE OF SURGEONS, at 4—Sir Cuthbert Wallace "The Hunterian Oration"

PHARMACEUTICAL SOCIETY, at 8 30—(at 17, Bloomsbury Square, London, W C 1)—Prof E Mellanby "The Influence of Some Nutritional Factors in Disease" *

Wednesday, February 14

INSTITUTION OF HEATING AND VENTILATING ENGINEERS, at 2—(at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W C 1)—Annual General Meeting

R C Ching Presidential Address

Sir Leonard Hill "Infra-Red Rays and Comfort"

EAST LONDON COLLEGE, at 4—Prof F E Fritsch "Certain Aspects of Algal Biology" (succeeding lectures on February 21, 28 and March 7, 14) *

Thursday, February 15

ROYAL SOCIETY, at 4 30—Dr J C Stimson "The Electrical Condition of Hot Surfaces" (5)

Prof G I Finch and B W Bradford "The Electrical Condition of Hot Surfaces" (6)

Prof G I Finch and A W Ikin "The Catalytic Properties and Structures of Metallic Films" (2)

S F Boys "Optical Rotatory Power A Theoretical Calculation for a Molecule Containing only Isotropic Refractive Centres"

CHEMICAL SOCIETY, at 8—Discussion on "Some Aspects of the Electronic Theory of Valency", to be opened by Prof J E Lennard-Jones

Friday, February 16

INSTITUTION OF CHEMICAL ENGINEERS, at 11—Annual Corporate Meeting to be held at the Hotel Victoria, Northumberland Avenue, London, W C 2

At 11 45 The Right Hon The Viscount Leverhulme "Chemical Engineering and the Edible Fat Industry" (*Presidential Address*)

At 2 15 Prof C H Lander "Modern Methods of Attacking Heat Transmission Problems"

GEOLOGICAL SOCIETY, at 3—Annual General Meeting Sir Thomas Holland Presidential Address

ASSOCIATION OF ECONOMIC BIOLOGISTS, at 3—(at the Imperial College of Science and Technology)—Annual General Meeting

Prof W B Brierley "Viewpoints in Applied Biology" (Presidential Address)

UNIVERSITY COLLEGE, LONDON, at 5.30—Sir Arthur Eddington "The Constitution of the Stars" (Rickman Godlee Lecture) *

ROYAL INSTITUTION, at 9—Dr Allan Ferguson "Surface Tension"

Official Publications Received

GREAT BRITAIN AND IRELAND

Department of Scientific and Industrial Research Report of the Reinforced Concrete Structures Committee of the Building Research Board, with Recommendations for a Code of Practice for the use of Reinforced Concrete in Buildings Pp iv+69 (London H M Stationery Office) 1s 3d net

Scottish National Development Council Economic Series No 9 Report of Committee on the Chemical Industry in Scotland Pp 80. (Glasgow Scottish National Development Council) 6d net

A Report on the Museums and Art Galleries of Australia, by S F Markham and Prof H C Richards, to the Carnegie Corporation of New York, and A Report on the Museums and Art Galleries of New Zealand, by S F Markham and W R. B Oliver, to the Carnegie Corporation of New York Pp v+113+13 plates (London Museums Association)

Geography Teaching in relation to World Citizenship By the Geography Panel of the League of Nations Union Education Committee Pp 31 (London League of Nations Union) 4d

Department of Scientific and Industrial Research Report for the Year 1932–33 (Cmd 4483) Pp iv+189 (London H M Stationery Office) 3s net

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1521 (T 3292) An Application of Prandtl Theory to an Airscrew By C N H Lock Pp v+41+11 plates 2s 3d net No 1539 (T 3275) Abstract—Flow Past Circular Cylinders at Low Speeds By Dr A Thom Pp 2+2 plates 3d net No 1540 (F M 87) Abstract—Convection of Heat from Isolated Plates and Cylinders in an Inviscid Stream By Dr N A V Piercy and Dr H F Winny Pp 2 2d net No 1553 (Strut 133a) Summary of the Present State of Knowledge regarding Sheet Metal Construction By H L Cox Pp 20 1s net (London H M Stationery Office)

OTHER COUNTRIES

University of Arizona Bulletin Vol 4, No 3 (Biological Science Bulletin No 1) Arizona Cacti By William Palmer Stockwell and Lucretia Breazeale Pp 116 (Tucson, Ariz University of Arizona) 25 cents

University of California Publications in American Archæology and Ethnology Vol 33, No 4 Clan and Moiety in Native America By Ronald L Olson Pp iii+351–421 (Berkeley, Calif University of California Press London Cambridge University Press) 80 cents

Reprint and Circular Series of the National Research Council No 105 Doctorates conferred in the Sciences by American Universities, 1932–1933 Compiled by Callie Hull and Clarence J West Pp 63 50 cents No 106 A History of the National Research Council, 1919–1933 Pp 61 50 cents (Washington, D C National Academy of Sciences)

Smithsonian Institution United States National Museum Bulletin 165 The Bryozoan Fauna of the Vincentown Limesand By Ferdinand Canu and Ray S Bassler Pp v+108+21 plates (Washington, D C Government Printing Office) 20 cents

Cornell University Agricultural Experiment Station Bulletin 561. Buying for the Household as practiced by 368 Farm Families in New York, 1928–1929 By Marion Fish Pp 92 Bulletin 563 A Study of the Food Habits and Health of Farm Families in Tompkins County, New York By Nancy Booker Morey Pp 83 Bulletin 565 Costs and Returns in Producing Apples in the Newfane-Olcott Area, Niagara County, New York, 1926–1928 By T E La Mont Pp 87. Bulletin 568 Costs and Returns in Producing Potatoes in New York in 1929 By F L Underwood Pp 122 Bulletin 571 Studies in Plant Propagation—The Influence of Chemicals, of the Medium, and of the Position of the Basal Cut, on the Rooting of Evergreen and Deciduous Cuttings By L C Chadwick Pp 53 Bulletin 573 Nut Growing in New York State By L H MacDaniels Pp 24 (Ithaca, N Y)

Zoologica Vol 9, No 16 The Fishes of Barro Colorado, Gatun Lake, Panama By C M Breder, Jr Pp 565–572 (New York City New York Zoological Society)

U S Department of the Interior Geological Survey Water-Supply Paper 732 Surface Water Supply of the United States, 1932 Part 7 Lower Mississippi River Basin Pp v+132 10 cents Water-Supply Paper 734 Surface Water Supply of the United States, 1932 Part 9 Colorado River Basin Pp v+137 10 cents Bulletin 842 Metalliferous Deposits of the Greater Helena Mining Region, Montana By J T Pardee and F C Schrader Pp xi+318+47 plates 70 cents Bulletin 849–F Lode Deposits of Eureka and Vicinity, Kantishna District, Alaska By Francis G Wells (Investigations in Alaska Railroad Belt, 1931) Pp viii+335–379+plates 29–32. 20 cents Bulletin 849–H The Valdez Creek Mining District, Alaska By Clyde P Ross (Investigations in Alaska Railroad Belt, 1931) Pp viii+425–468+plates 34–35 15 cents Bulletin 849–I The Moose Pass Hope District, Kenai Peninsula, Alaska By Ralph Tuck (Investigations in Alaska Railroad Belt, 1931) Pp x+469–530+plate 36 15 cents (Washington, D C Government Printing Office)

Report of the Secretary of the Smithsonian Institution and Financial Report of the Executive Committee of the Board of Regents for the Year ending June 30, 1933 (Publication 3225) Pp viii+194 (Washington, D C Government Printing Office)

Publications of the Dominion Observatory, Ottawa Vol 10. Bibliography of Seismology, No 19 July, August, September 1933 By Ernest A Hodgson. Pp 321–336 (Ottawa King's Printer.) 25 cents

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Peace and War

RECENT events have suggested that the modern organised State, closely linked as it is with the highly emotional concepts of the new nationalism, might prove a danger in the way of the free pursuit of scientific inquiry, and that it has already affected the international standing of science It may be argued with equal justice that such a State is also a menace to the present nicely adjusted equilibrium of forces between the Powers which we call by the name of peace The responsibility for the feeling of instability in the present international situation, of which every nation is conscious, is to be attributed, not so much to the activities of Herr Hitler and President Roosevelt in the political and economic fields—though these may seem to run counter to any progress towards a solution of world-wide problems on a world-wide basis—as to the spirit of aggressive self-expression and integration characteristic of present-day nationalism This spirit emphasises and glorifies national distinctions, oblivious of the consciousness of a common humanity, to which much is forgiven and in which differences are composed rather than made the cause of offence By the stress laid on nationality the urge towards the larger unity is repressed.

Many have asked why mankind for ages should have lived under the constant menace of war. War has been sung by the poets and glorified by the historians, and for certain individuals, and perhaps even to whole hordes which have been dignified by the title of races, the career of arms has represented the fullest expression of man's essential nature. Yet it may be questioned whether the adventurous spirit and the joy of battle are commonly the obstacles in the way of peace they are sometimes said to be, especially when the conditions of modern warfare are kept in mind

If there is one thing that may be affirmed with certainty to-day, it is that a majority of the nations of the world do not desire war. Yet all are watching anxiously for the spark which may light a conflagration destined in all probability utterly to destroy the civilisation of the western world, and beyond disarmament no suggestion is put forward as a remedy. It is, therefore, all the more an urgent necessity, as Lord Raglan points out in his recently published book, "The Science of Peace",* that the underlying forces operative in bringing about wars should be understood. For neither pacifists nor the League of Nations will ensure peace until the factors by which it is endangered have been eliminated, even though the facile argument of despair may reiterate its belief that the situation is brought about inevitably by man's instinctive tendency to pugnacity

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* The Science of Peace. By Lord Raglan. Pp. x+165. (London. Methuen and Co, Ltd., 1933.) 5s 6d net

Modern Germany—unfortunately specific reference in this context is inevitable—has glorified and idealised war Although the Chancellor has expressed his devotion to the cause of peace, and the recently concluded agreement with Poland, which apparently would eliminate the Polish Corridor as a *casus belli* for a period of at least ten years, is an earnest of good intention, nevertheless the youth of Germany is disciplined in the belief that war, rather than peace, is the arena for the fullest exercise of civic virtue, as well as the noblest training ground of the citizen A warlike and aggressive spirit which fights blindly for its tribe is displayed for emulation as the Aryan's virtue If by 'Aryan' we are to understand 'Nordic', as presumably we must, it is a strange turn of the wheel that has made a nation, which only a short while ago claimed to have led the world in philosophy, science and certain branches of the arts, now seek to mould itself on the pattern of peoples who were the destroyers and not the founders of civilisations But neither physical nor cultural anthropology endorses the exclusive ideal of 'Aryanism' as having a basis in historic fact , and a patriotism which pursues its end without regard to considerations of logic or common sense may in the long run be as destructive of the Fatherland as treason. For good or for evil, Germany affirms her belief in the struggle for existence as a conflict among nations, and in survival as determined by the arbitrament of war

The fighting qualities of the Nordics cannot be quoted in support of any theory of the innate pugnacity of primitive man, for they were barbarians rather than primitive Dr W. J Perry has collected a considerable body of evidence to show that the peoples of the lower culture are essentially peaceable, and Lord Raglan accepts this view, while pointing out that organised aggressive warfare begins at a later stage of social development, in which ritual ceremonial requires a periodical, and often considerable, supply of captives to provide for human sacrifice. There are others, however, who view the primitive state and the evolution of man at a different angle The life of primitive man, like that of modern man, is many-sided, and each observer is apt to regard it from the point of view of his own special interest

Sir Arthur Keith, for example, essentially a Darwinian, like Hobbes of 'Leviathan' fame, sees Nature as a state of war. For him the advance from primitive to civilised has been achieved in a struggle for existence by which peoples have been welded into nations—races in process of becoming Warfare, in fact, he holds, is one of the forms of machinery whereby Nature works in the satisfaction of a biological urge towards the establishment of the more highly specialised type, a position which it must be admitted is not unlike that of Hitler himself Here indeed the difference between Sir Arthur Keith and Lord Raglan becomes most apparent, for while the latter, viewing the situation as a social anthropologist, arrives at the conclusion that the obstacle in the way of peace and of peaceful mindedness in the peoples of the world to-day is the concept of nationality, Sir Arthur sees in the nation a stage, achieved by struggle, on the way to peace—to be more fully attained by the apotheosis of the nation in a federation such as the British Commonwealth of Nations

It may seem that Sir Arthur Keith's patriotic enthusiasm for the British Empire has warped his sense of logic , but the fallacy is formal rather than material. If we could look on the hideous slaughter, the cruelty and brutalities of war, which have disfigured the history of mankind, with the same detachment as we view the survival of the fittest among the millions of the lower organisms, would it be possible to say that the results of war have not been beneficial and in the long run have conduced to the advancement of mankind—as, for example, in the conquests of Alexander and Julius Caesar ? To deny it would be to affirm that the peoples then drawn into the main stream of history would have developed along lines equally or more conducive to progress without the intervention of conquest—a contention incapable of proof, however high may seem the degree of its probability. On the other hand, to admit the validity of the argument is not to deny the advantage, indeed, we may even say the necessity, of peace for the future War has become an anachronism, in which the wastage of life and material are more than the belligerents, and often in these days of universal reactions, more than the world at large, is able to endure

The predominant characteristic in modern civilisation is its constant advance towards a more complete scientific understanding of conditions in all departments of human life It would be an ironical commentary on man's ability to control the material conditions of existence if he were unable to understand and guide forces within himself which threaten him with destruction.

The one essential factor is not so much the elimination of the causes which have led, and may still lead, to war, though naturally this has its importance, as the creation of a peace which is a habit of mind among peoples and not as it now is, a state of unstable equilibrium, maintained by the sanction of force, in which the nations are on the alert for the outbreak of war.

How this habit of mind is to be attained is a problem which should not be beyond the possibility of solution Obviously that solution does not lie in disarmament alone Disarmament, however attractive in theory, may become a forcing house for jealousies, rivalry and suspicion Nor does experience endorse the claim of the League of Nations If we may rely upon the evidence of man's social development in the past, it would seem that we must look rather to a general and widely-distributed consciousness of group-solidarity ; but it must not be the narrow group-consciousness of 'nationalism' The *Pax Romana* is an obvious analogy The *Pax Romana* endured in the consciousness of a common citizenship which embraced all but the outer fringes of the then known world. The studies of the social anthropologist tell us of the homogeneity which rules within the primitive social group. He shows us how its extension may be followed in the development of the social organism by aggregation as family group merges into tribe, tribe into people and people into nation Within these groups and between their members, as a normal condition, there is peace. Broadly speaking, and in general terms, this has been the rule in the modern State. Only on rare occasions has social unrest produced disturbance sufficiently serious to amount to war.

It is obvious that the larger the proportion of the world's peoples to be brought within the political unit, the greater the possibilities of a permanent peace. By 1914 the nation, in the traditional form in which it had existed in the previous hundred years, had outgrown its utility in relation to the needs of international politics, commerce and finance. It was this which, by restricting Germany's power of expansion, was in part responsible for the War of 1914–18 , and now, after that War, the problem of peace is even more closely bound up with the necessity for developing some new and more elastic form of political aggregation. We are, as it would appear, moving towards new political forms , but whether in the present temper of the nations they will conduce to peace or lead to a war more catastrophic than the last, seems to be left to blind chance Russia and Italy have each applied a new spirit within old political boundaries, while America, southward of the Canadian line, stands aloof behind the possibilities of a revitalised Monroe Doctrine France in its colonial policy of citizenship for its subject races, and Great Britain in the Statute of Westminster and the inauguration of Dominion status have each made their contribution to the future development of the political organism The crux of the situation is Germany. Will the historian of the future write down the 'tribalism', which would substitute tribal for State boundaries within the Reich and proposes to overleap political frontiers, as a mere reactionary archaism or as a stage towards the formation of a great pan-Teutonic union of the peoples of Central and Northern Europe on 'racial' lines, towards which the approach to Austria marks an attempt to take the first step ?

Goodyer's Dioscorides

The Greek Herbal of Dioscorides Illustrated by a Byzantine A.D 512, Englished by John Goodyer A D. 1655, Edited and first printed A.D 1933 by Dr Robert T. Gunther Pp x+701. (Oxford Dr. Robert T Gunther, 5 Folly Bridge, 1934) n p

IN 1909 the late Canon Vaughan of Winchester, having seen the collection of books on botany bequeathed to Magdalen College, Oxford, by Mr John Goodyer (1592–1664), described Goodyer as "a forgotten botanist of the seventeenth century" The Canon was Rector of Droxford : we know that many of the plants the descriptions of which by Goodyer were printed by Dr Thomas Johnson in 1633 in his revised version of the rather unsatisfactory "Herbal" which Mr. John Gerard (1525–1612) published in 1597, were grown in Goodyer's garden at Droxford. But as one of these plants was the "edible Sunflower", the first tuber of which Goodyer had planted by March 25, 1617, and as Goodyer was able to report on October 17, 1621, that he had already "stocked Hampshire" with "this wonderfull increasinge plant", we know that, whatever may have been the case with botanists, the memory of Goodyer has survived among gardeners interested in the history of their craft. In his introduction to the revision of Gerard's "Herbal", Johnson informed his readers that Goodyer was the friend who had rendered him most assistance in that undertaking, and declared that his friend was "a man second to none in his industrie and searching of plants, nor in his judgment or knowledge of them" The trifling amount of editorial modification bestowed on some of the descriptions with which Goodyer supplied him, suggests that Johnson was as much struck by the judgment his friend showed in recording his observations as by the knowledge these observations had yielded

In the "Sketch of the Progress of Botany in England" published in 1790, Dr R Pulteney (1730–1801), on the authority of Johnson, who died in 1644 of wounds received during the defence of Basing, and of Mr. John Parkinson, who died soon after the publication of his "Theatrum" in 1640, regarded Goodyer as entitled "to the most reputable rank among those who have advanced the botanical knowledge of this kingdom", and added, on the evidence of a "curious communication" which had struck himself, that Goodyer must be inferred "not only to have been what may be called a *practical* botanist, but learned and critically versed in the history of the science"

In 1919 Dr R T. Gunther, as librarian of Magdalen, began an exhaustive study of the books and papers which reached the College in 1665, and in 1922 placed his results at the service of botanists in the charming volume entitled "Early British Botanists" From its pages we learn that by 1616, Goodyer had already begun the formation of a botanical library, that he may have been in personal touch with Johnson in November, 1618; that during the period of June–October 1621, he wrote some ninety descriptions of plants for his friend, and during the next ten years he prepared some thirty more; that Johnson and Goodyer were in London together in November, 1631, and that the one hundred and twenty descriptions he had drawn up for Johnson were sent to his friend in three instalments on March 5, March 12 and March 19, 1632 These facts may explain the origin of the misleading tradition that Johnson revised Gerard's "Herbal" in the short period of twelve months.

Among the volumes Goodyer had already acquired in 1621 appears to have been his copy of the Aldine "Theophrastus" of 1497. By way of relaxation after the spell of descriptive drudgery during the summer and autumn of 1621, he devoted the winter of that year as well as the winter of the following year to the translation, first of "De Plantis", and then of "De Causis Plantarum". Goodyer's English version of "De Plantis" was the only one known to exist until the publication in 1919 of that by Sir Arthur Hort. so far as is known, the manuscript translation in the library of Magdalen College prepared by Goodyer in 1622–23 is still the only English version of "De Causis Plantarum".

Thirty years later, Goodyer began at 10 a.m on April 29, 1652, to prepare an English version of Dioscorides. This task was completed in the forenoon of August 29, 1655, and at 2 p m on that day he began to transcribe the Greek text corresponding with the English translation. This supplementary task was completed on March 17 following and, three days later, at 11 a m. on March 20, he began a translation of the "Scholia" on Dioscorides which A Saracen dedicated to Henri IV and published at Lyons in 1598 In the preparation of the English version of Dioscorides, Goodyer had the assistance, apparently subsidised, of another scholar, possibly his friend and neighbour, the Rev John Heath. That this arrangement subsisted in connexion with the "Scholia" seems clear, that, in this case, the assistant was Heath is almost certain, for the translation of the "Scholia" ended abruptly on October 2, 1656, to be followed by an entry intimating that the Rev. John Heath had died on November 25, 1656. The facts adduced by Dr. Gunther, if they do nothing else, at least show how fully warranted was the inference drawn by Dr. Pulteney in 1790.

In his "Dioscorides. illustrated by a Byzantine: Englished by John Goodyer" Dr. Gunther has now (1934) further safeguarded the "pious memory" of a remarkable Englishman and supplied botanists with a gift that, through no fault of Goodyer, has been withheld for two and a half centuries from those Goodyer wished to benefit. The illustrations bear no direct relationship to Goodyer's version of the text. They reproduce the drawings in the Codex of Dioscorides prepared in A.D. 512 for the Lady Juliana Anicia, daughter of Olybrius, the head of the Anician house who was Emperor of the West for a few months in A.D. 472. Some figures may, it is thought, be copies of plant-portraits approved by Crateuas, a century and a half before Dioscorides became an army surgeon in Nero's reign: some, it is clear, can only be drawings of plants which herbalists contemporary with the lady for whom they worked thought might be those Dioscorides had in mind. In quality they vary from portraits that would do credit to a Renaissance herbal, to caricatures that the editors of the "Hortus Sanitatis" might have rejected.

As Dr. Gunther showed in 1922, Goodyer in his later years took to prescribing for sick domestics and neighbours: it is possible that this new interest may have led him to consult the herbal of Dr. William Turner (1515–1568) and to note Turner's remark regarding an item "whiche a lytle before I have taken out of Dioscorides and translated unto you". In any event, Goodyer in 1652 followed the example of the Dean of Wells and began to translate Dioscorides

The fact that Goodyer translated Theophrastus when he was thirty-two and did not begin to translate Dioscorides until he was sixty-one, is not the only reason we have for thinking that Goodyer was not, at heart, a herbalist A popular work published at Oxford in 1659 shows that the herbalist relied on phytology . "the Art of knowing and finding out the Temperature, Vertue and Use of Plants, as serving to the Curation and Sustentation of the Body" . empirical acquaintance with the qualities of plants determined his efforts at classification and guided his attempts at identification. But in Central Europe the portraits of plants in herbals were gradually becoming more reliable, and in Southern Europe the discriptions of plants were becoming more methodical. As a result it was being realised that it was easier to identify plants by their characters than by their qualities, and though classification by qualities still remained in vogue it was safer to identify plants first and study their qualities after their identity had been determined: Botany, "the Science of knowing and naming Plants" was recognised as a safer guide than "the Art of Phytology".

That Goodyer was a master of method his plant-descriptions show, though he did not, like the Rev. John Ray (1628–1705), employ method as an aid to classification. Nor can we venture to say of Goodyer as the Rev Gilbert White (1720–1793) said in 1771, that "our countryman, the excellent Mr. Ray, is the only describer that conveys some precise idea in every term or word". But we can say of Goodyer what Dr. Gunther's eminent father said, a century after Mr. White, of "a forgotten zoologist of the eighteenth century", that he was "one who recorded, in absolute truthfulness, the results of his own observation and nothing more or else" This trait is as marked in Goodyer's English version of Dioscorides as in his descriptions of plants: he did not, like the Dean of Wells, interpolate his own remarks in the matter translated from Dioscorides, nor did he substitute a synonym for a "caption" selected by Dioscorides himself. For this reason botanists may regret less than scholars must, the fact that Dr. Gunther has not been able to include in his pleasing volume the Greek text of Dioscorides transcribed by Goodyer in 1655 after his English version was finished. That text, which should correspond with the English version, was the result, as Dr. Gunther explained in 1922, of a study of eighteen texts of Dioscorides. Botanists and scholars alike would have been glad of an opportunity to compare the recension made in 1830 by a scholar so eminent as Sprengel with the one effected in 1655 by so competent a botanist as Goodyer For if Rousseau "had reason" when he said that Theophrastus was the one *real* botanist the ancient world produced—other classical authorities on plants being only phytologists—we with equal reason are entitled to say that Goodyer was the first *real* English botanist.

Dr. Gunther can feel assured that botanists are deeply indebted to him for the services he has already rendered them, but he must be prepared to find that they resemble Oliver Twist and that they will appeal to him to favour them one day with Goodyer's English version of "De Causis Plantarum", while scholars will join with them in begging him to give them, if possible, at the same time Goodyer's recension of the Greek text.

Light and Health

The Physiological Effects of Radiant Energy By Prof Henry Laurens (American Chemical Society Monograph Series, No. 62) Pp 610. (New York The Chemical Catalog Co., Inc, 1933) 6 dollars

THE recent widespread interest in the therapeutic effects of ultra-violet radiation has led to the publication of so many original papers, that it is difficult to form any clear picture of the data as yet ascertained. Hence a summary of this type is welcome, and will give many research workers yet another reason for gratitude to the American Chemical Society for the series of monographs of which this is the sixty-second.

The book is confined almost entirely to radiations of medium wave-length, from ultra-violet to infra-red, and thus omits the important but very different effects of X-rays, and those of the relatively long-wave electromagnetic radiations of which the biological application has only begun in the last few years. However, the field covered is quite wide enough for one volume A chapter on the physics and measurement of the radiation concerned is followed by chapters on the effects on the skin, on wounds, on the eye, and on the circulatory system. The effects of radiation on metabolism are given 224 pages of discussion, which include a detailed account of the work leading to the preparation and isolation of vitamin D Later chapters include an account of the striking phenomena of photodynamic sensitisation, and of a study of the results of heliotherapy in tuberculosis The book ends with a useful bibliography of about 900 references

The reader is left with a feeling of disappointment that in spite of so much study, so few conclusions can be drawn with any certainty As the author says in an admirable preface, "Many readers will be annoyed at the inconclusiveness of some of the statements" This is so true that one wishes that the author had added to each section a summary showing what conclusions could be drawn with safety from the rather confusing mass of data presented to the reader Such summaries, if made with the sound judgment shown in the preface and introduction, would have added much to the value of the book

Much of the uncertainty is due to the exceptional difficulties met by research workers in this subject. Physicists, who are accustomed to have some control of the major variables concerned in their experiments, might well be appalled at the difficulties met with in studying such a problem as 'the therapeutic effects of ultra-violet light' In this work, almost the only major variables that can be controlled accurately are the time of exposure to radiation and the sex of the persons receiving it A host of other variables escape control to a greater or less extent, such as the source of radiation, the degree of disease in different patients, the blood supply to the skin, the diet, and even the regularity of attendance at the clinic. All these may form serious sources of error, and it is because of such difficulties that the author can sadly remark, "The real mode of action of radiant energy and its component parts is still unknown".

Modern Research in Astronomy

The Universe Around Us. By Sir James Jeans. Third edition, revised and enlarged. Pp x + 380 + 30 plates (Cambridge · At the University Press, 1933) 12*s* 6*d* net

THE three years which have elapsed since the publication of the second edition of this book have been fruitful in discovery in both physics and astronomy To the two fundamental units of which matter was believed to be composed, the proton and the electron, have been added the neutron and the positron The exclusion principle has assumed great prominence and many investigations have been concerned with the properties and nature of the highly penetrating or cosmic radiation Much attention has been given to the theory of the expansion of the universe and to the question whether the observed rate of expansion, indicating a relatively short time-scale for the age of the universe, can be reconciled with the much longer time-scale which many lines of evidence point to for the evolution of the stars , or whether, on the other hand, previous conceptions must be abandoned and the short time-scale adopted for the stars also

These new problems are all dealt with in the third edition of Sir James Jeans's well-known book, which has been at the same time thoroughly revised The arguments for and against both the short and long time-scales of stellar evolution are discussed in some detail Sir James favours the long time-scale , this time-scale can be harmonised with the observed data as to the velocities of recession of the spiral nebulæ if, as de Sitter has shown, the universe is supposed to be either in a state of pulsation or to have undergone in the past a single contraction from an expanded state, followed by the expansion which is now in progress

The new material makes the present edition substantially longer than the previous editions. The book retains its place as the best account available, in simple language, of the results of modern astronomical research and of their interpretation The book is so free from mis-statements that attention must be directed to the statement on p. 277, repeated again on p. 290, that Nova Aquilæ when at its brightest had an effective temperature of 65,000° It was only in the later stages of its outburst, long after maximum brightness had passed, that Nova Aquilæ or any nova attained temperatures of this magnitude.

Short Reviews

All about Fish and other Denizens of the Seas and Rivers. By W. S. Berridge Pp. 254+63 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1933.) 7*s.* 6*d.* net.

MR. BERRIDGE fills his pages with a large amount of interesting information concerning marine animals. There are chapters on fish in general, fish that make nests, the food of fish, luminous fish, electric fish, goldfish, and many other animals including invertebrates such as oysters and cockles, lobsters and shrimps, corals and sponges. The book is amusing and the original photographs are good, sometimes very good, but it is a pity that they do not match the text, for when reading about a basking-shark or a sea-serpent we find pictures of goldfish, and a remora illustrates the remarks on oysters.

Much that is instructive is included in the accounts of the habits and peculiarities of marine animals, some of world-wide distribution. However, there are a few statements which might be altered to advantage. For example, one would certainly infer from the author's notes that *Noctiluca* is rare off British coasts when in reality it is common but erratic in its appearances, and although it is extremely important as a light-giving organism, there are many other minute members of the plankton which may cause phosphorescence, or luminescence, in the sea Again, the British squid may breed in almost any month of the year and not in May and June only, and the pea-crab, which is stated to be fairly common off the Irish coast, may be found in mussels on almost any suitable bed.

Mimicry By Prof. G. D. Hale Carpenter. With a Section on its Genetic Aspect by E B. Ford (Methuen's Monographs on Biological Subjects.) Pp ix+134 (London. Methuen and Co, Ltd, 1933) 3*s* 6*d* net

THIS little book is intended to present the theory of mimicry as developed by natural selection All those who accept the theory and delight in finding new proofs for it will welcome the book, since the author has produced a clear and concise summary of the main facts and arguments in its favour. On the other hand, the treatment accorded to criticisms of the theory is very inadequate, and some of the most serious objections to it are dismissed in a few words; while the opinions of some well-known critics of the theory cannot be found in the text, and their works do not appear in the list of references. The latter is very complete with regard to some authors but it is surprising not to see in it any works except in English. This may create an impression that the mimicry theory has no followers and supporters outside Great Britain. Actually, this is not so, and it would strengthen the case of mimicry if at least the outstanding Continental and American contributions to it were quoted.

Causality: a Law of Nature or a Maxim of the Naturalist? Lecture delivered at the Royal York Hotel, Toronto, on May 14th, 1932, much enlarged By Dr. Ludwik Silberstein Pp. viii+159 (London: Macmillan and Co, Ltd, 1933.) 4*s* 6*d*. net.

As a forceful defence of the principle of determinism in Nature, as against the current interpretations of the new physical theories, this book needs careful thought The author believes that the menace to determinism is rather premature and marks only a provisional stage in the re-shaping of the foundations of physical science A correct interpretation of the principle of causality would show that Nature is not necessarily left to chance. This interpretation consists in considering the principle of causality as a maxim of the naturalist rather than a law of Nature In this heuristic capacity, the principle is used to supplement, with other fragments of Nature, every incomplete system encountered, until it is amplified to a complete, undisturbed whole T. G.

Geschlechtsgebundene und geschlechtskontrollierte Vererbung By Björn Föyn (Handbuch der Vererbungswissenschaft, herausgegeben von E Baur und M Hartmann, Band 1, Lief. 17.) Pp iv+122 (Berlin Gebrüder Borntraeger, 1932) 25.20 gold marks.

THIS is a summary of recent knowledge of sex-linked and sex-controlled, or sex-limited, inheritance, including the recent genetical and cytological studies of sex-linked inheritance in *Abraxas*, *Drosophila*, *Sciara* and *Phytodecta* among insects; *Lebistes* and *Aplocheilus* among fishes, and *Melandrium* among plants. Each case is carefully elucidated, with a free use of illustrations. Many other animals are considered in the special part, and there is a brief statement concerning the sex-chromosomes and sex-linked inheritance in man. A bibliography of twenty pages completes a very useful summary of this field of heredity.

The Aquarium. By E G Boulenger. Pp. 71. (London: *Poultry World*, Ltd., 1933.) 1*s.* 6*d* net.

THOSE who wish to keep a fresh-water aquarium would do well to provide themselves with this little book, which contains a large amount of useful information. First comes the making of the aquarium and the plants which are most suitable for it; following this there are chapters on goldfish, cold-water fish and tropical fish, with notes on the habits, food and proper treatment of each species. These notes are interesting and amusing, and one can learn much from such a short survey. The illustrations, figuring most of the best-known aquarium fish, are by Mr. L. R. Brightwell, who always imparts an individuality to every creature he draws.

The Indian Earthquake (1934) Area

By Dr J. de Graaff Hunter, C.I.E.

MUCH attention has been recently focused on Bihar and Orissa Province as a result of the disastrous earthquake of January 15, and some facts about the condition of the earth's crust in that region have an enhanced interest It is, of course, no consolation to those who have suffered by the earthquake to be told that there were good reasons for it. These reasons have been in existence for a long time and yet, so far as I am aware, no earthquake of any magnitude has occurred there during the previous century.

The area roughly bounded on the north by the Himalayan foothills, on the south by the Ganges River and stretching from Meerut to beyond Darjeeling, between longitudes 78° and 89° is one of excessive underloading in the earth's crust (Fig 1) The average underloading of this area of about 100,000 square miles is on the average equivalent to a thickness of rock of more than 3,000 ft.; or, put otherwise, the deficiency of pressure in the crust is above 200 tons per square foot. This underloading arises from abnormally low densities in the crust It is in part accounted for by the low density of the alluvium of the Ganges valley; but unless this alluvium extends to a greater depth than most geologists would believe, the explanation is not wholly there

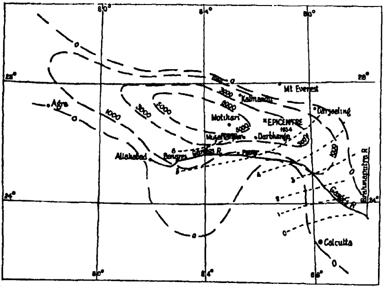

FIG 1 Sketch map showing main region of underload in Bengal, Bihar, etc and secular changes of level in Bengal

——— ——— ———, contours of underload in feet of equivalent thickness of rock, density 2 67

- - - - - - -, generalised contours of secular change of crustal level in feet per century

The presence of this region of underloading is revealed by measurements of the shape of the earth which have been accumulated during the past century by the Survey of India The area of underload is flanked both on the north and on the south by regions of overload; and the total overloading of the two outer regions is roughly equal to the underloading of the Ganges valley. Both the underload and overloads are reckoned from a state of isostatic compensation; so the northerly area of overload is not to be thought of as the weight of the Himalaya but something much smaller, as a considerable degree of compensation of the Himalaya is existent

These regions of great loading anomaly must cause very great stress-differences in the earth's crust which supports them The region of underload and the amount of underloading are very much of the order which has been estimated by Dr H Jeffreys to be sufficient to cause fracture in the lithosphere Now these stresses have no doubt been in existence for a long time In so far as the land level has been rising from sedimentation, known to have been in progress, some measure of relief has been afforded; but this has not been more than a small palliative. Meanwhile, evidence of another kind has recently come to light —again from the measurements of the Survey of India.

In 1858, spirit-levelling operations on a comprehensive scale were begun in India by General Walker. In 1862 work was carried out in Bengal, and since then measurements of this kind have accumulated. This accumulation gave rise to some embarrassment a few years ago, in that the newer lines of levelling gave results at variance with those of the older lines. After the whole system of lines had been carefully scrutinised, it was found that the apparent discrepancies would all be accounted for on the hypothesis that the land level had been rising so much each year, the rate of rise varying from place to place in a nearly uniform manner Thus along a line passing a little north of Benares and directed towards east-north-east an annual increase of elevation of 0·06 ft. was found; and other lines, approximately evenly spaced and roughly parallel to the first, showed rates of increase of 0 05, 0·04, 0 03, 0·02, 0 01, 0·00, the last being some fifty miles from Calcutta

It will be seen that this rising of the land is occurring in the south-east quadrant of this area of excessive underloading in the earth's crust. It is not necessarily confined to that quadrant. Evidence of change of level from spirit levelling results elsewhere has not yet been so carefully analysed, being not sufficiently complete None the less, revision levelling in the present century shows a persistent rise from Dhulia (lat. 20·9°, long. 74·7°) to Cawnpore (which also shows a small rise from Benares); and this, so far as it goes, confirms the Bengal results, which in turn are closely in sympathy with the underloading of which they are a natural consequence.

Before the earthquake occurred, the relevant facts accordingly were (*a*) that there was a large area of serious underloading, flanked by areas of overloading; (*b*) that in the part of this region where spirit levelled heights had been determined in sufficient detail at sufficient time intervals, the results indicated that the land has been rising steadily where the underload occurs, the rate of rise increasing as the centre of that region is approached.

A slow but continuous yielding of the crust has been in progress. When a material is stressed beyond its elastic limit, it yields in a non-elastic way and eventually fractures. In the present case, the earthquake gives evidence of fracture having occurred; and the floods which have followed the earthquake indicate the resulting rising of some portions of the area.

In the case of such a large area, fracture is not likely to extend throughout the entire region of stress, but it occurs at the position where the relation of stress to strength is most severe, and leads to a modification of the general stress distribution. There is no question of one earthquake of the magnitude of that which has recently occurred entirely relieving the stress differences. To do that an uplift amounting to thousands of feet would be necessary I have little doubt that spirit levelling will show that there has been some sudden rising of the land Were this of the order of tens of feet, it would immediately be made apparent by a wholesale change in the courses of the local rivers; and indeed, a recent report in the Press states that one of the most impressive features of the disaster has been such changes in river courses.

As stated earlier, the area from Meerut to Darjeeling is one of excessive underloading. A smaller amount of underload exists over a much larger area—a strip skirting the Himalaya from the Punjab to Bengal of width varying from 150 miles to twice that amount. We have so far discussed the eastern portion which provides the area of most acute underloading; but there is another region, roughly centred on Lahore (31 6°, 74 3°) where underloading of very considerable amount—about 2,000 ft of rock-equivalent—exists This region is not completely defined, as in the north-west it passes out of the area for which the necessary geodetic observations have been made It is just in this neighbourhood that the last serious Indian earthquake—Kangra (32°, 77°)—occurred in 1905. Eight years previously, in 1897, there was the Shillong earthquake, with epicentre at 26°, 91° Unfortunately, this is outside the area of full geodetic survey, and spirit levelling was not commenced in that region until 1900, so as yet we have no knowledge of what anomalies of loading exist there or of the secular changes of ground height

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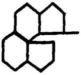
Recent Developments of Sterol Chemistry in Relation to Biological Problems

By JOHN PRYDE

ONCE again there has been demonstrated in striking fashion the impetus which organic chemistry gains from biology, and how a field of organic research, formerly of purely academic interest, enters on a fresh phase of development in virtue of a new correlation with biological problems The field in question is that of the sterols and the polycyclic aromatic hydrocarbons



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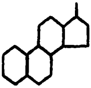
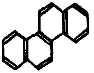


II

It is well known that the fundamental researches of Wieland, Windaus, Mauthner, Borsche, Diels and others on the sterols and bile acids received a new interest on the isolation of calciferol (vitamin D) from the products of irradiation of ergosterol, $C_{28}H_{44}O$, with which the vitamin is isomeric, and that our conceptions of the structure of these, and of other members of the cholane series to which they belong, have been re-oriented by the new formulæ advanced by Rosenheim and King[1]. The structures below show the old (I) and the now accepted representation (II) of the cholane nucleus. The new, and at the time somewhat revolutionary, formulæ conferred a great stimulus on the investigation of the whole series of compounds They are based upon evidence which cannot be detailed here, but some of the more salient of the recent observations can be summarised



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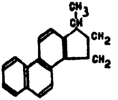
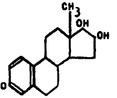


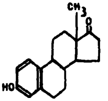
IV

Thus, on drastic dehydrogenation with palladium-charcoal or zinc, cholesterol and cholic acid yield the fully aromatic hydrocarbon chrysene (III)[2], whilst less drastic dehydrogenation of these compounds and of ergosterol using selenium yields an interesting hydrocarbon of the composition $C_{18}H_{16}$, first obtained by Diels and his associates[3]. For this latter the constitution IV was suggested by Rosenheim and King[4]. Kon[5] has very recently proved the correctness of this suggestion by a synthesis yielding the desired 3-methyl*cyclo*pentenophenanthrene. It is therefore clear that the formation of chrysene in the more drastic process is due to ring enlargement associated with the migration of a methyl group, and the revised cholane formula of Rosenheim and King becomes firmly established upon fact.

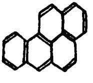
Secondly, the recent isolation and investigation of the female sex (œstrous-producing) hormone, mainly due to the efforts of Doisy in the United States, Marrian in Great Britain, and Butenandt in Germany, show that the hormone occurs in two forms—œstriol (V) and œstrone (VI), to adopt the nomenclature recently advanced in NATURE by workers in this field[6]. Evidence is available which amply establishes the close relationship of the œstrane and cholane series, which may be inferred from the isolation of the same 1 : 2-dimethylphenanthrene from œstriol and from ætiobilianic acid of the cholane series[7]. Mention may also be made of the isolation from œstrone, after dehydrogenation in the presence of zinc, of a hydrocarbon of the same C_{18} series as that obtained from the cholane compounds. To this hydrocarbon Butenandt has ascribed the composition $C_{18}H_{14}$, but in all probability the compound is impure chrysene $C_{18}H_{12}$.



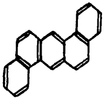
V



VI



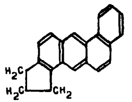
VII



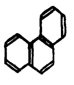
VIII

Thirdly, it has been known for many years that the tars and pitches resulting from the pyrogenic decomposition of coal and other organic products frequently possess carcinogenic properties. Much patient work in Great Britain, with which the names of Kennaway and Cook and their collaborators are associated, has culminated in the isolation[8] from a soft coal-tar pitch of a pure actively carcinogenic hydrocarbon, namely, 1 : 2-benzpyrene (VII). This, together with certain other but somewhat less active carcinogenic hydrocarbons [for example, 1 : 2 : 5 : 6-dibenzanthracene (VIII) and 5 : 6-*cyclo*penteno-1 : 2-benzanthracene (IX)][9] has been synthesised and the peculiar biological properties of these compounds have been amply proved.

It will therefore be realised that calciferol, œstrous-producing hormones, and carcinogenic hydrocarbons, all correlated with some phase of growth, all have the phenanthrene nucleus (X) in common. Lastly, the group of the cardiac-stimulating glucosides—strophanthin, digitoxin—yields aglucones in which the phenanthrene nucleus again occurs[10]. It may also be significant that some of the most powerful alkaloids, such as morphine, codeine, etc., of the opium group, the corydalis alkaloids and colchicine (meadow saffron) contain a phenanthrene nucleus. To this nucleus are added various cyclic and straight-chain substituents which confer on each group its characteristic biological activity.

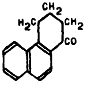


IX

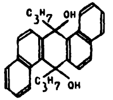


X

That these groups of compounds, of such apparently diversified physiological activities, should exhibit such fundamental constitutional similarities is sufficiently striking, but the story does not end here and indeed it would be bold to attempt to predict where it will end.



XI



XII

Mention has already been made in these columns[11] of the œstrogenic action of certain synthetic hydrocarbons and their derivatives—either themselves carcinogenic or closely related to carcinogenic compounds—and of the similar activity of some of the sterols and calciferol. Amongst the former are 1-keto-1 : 2 : 3 : 4-tetrahydrophenanthrene (XI) and 1 : 2 : 5 : 6-dibenz-9 : 10-di-*n*-propylanthraquinol (XII). In reference to the activity of the latter compound, it is of interest to note that a series of diols derived from 1 : 2 : 5 : 6-dibenzanthracene was investigated[12]. Of these the dimethyl, di-*n*-amyl, and di-*n*-hexyl compounds are inactive, whilst the intermediate diethyl, di-*n*-propyl and di-*n*-butyl compounds are all highly active, the propyl derivative showing the maximum activity The compounds mentioned above are the most active of those so far investigated, then follow in order of activity neoergosterol, 5 · 6-cyclopenteno-1 : 2-benzanthracene, 1 · 2-benzpyrene, calciferol and ergosterol That behaviour characteristic of a specific hormone should be shared by other compounds of related structure, some possessed of physiological activities of their own, provides a remarkable extension of our conceptions of biological specificity It suggests future developments of great interest in the chemistry and biology of the sterols and the polycyclic hydrocarbons

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[1] *J Soc Chem Ind*, 51, 464, 954, 1932

[2] Diels and Gädke, *Ber*, 60, (B), 140, 1927

[3] *Annalen*, 459, 1, 1927; 478, 129, 1930

[4] *J Soc Chem Ind*, 52, 299, 1933

[5] *ibid*, 950

[6] NATURE, 132, 205, Aug. 5, 1933

[7] Butenandt, *J Soc Chem Ind*, 52, 268, 287, 1933

[8] Cook, Hewett and Hieger, *J Chem Soc*, 395, 1933

[9] *Proc Roy Soc*, B, 111 455, 485, 1932

[10] Jacobs and Fleck, *J Biol Chem*, 97, 57, 1932

[11] NATURE, 132, 1933

[12] Discussed at a meeting of the Royal Society on Nov 16, 1933

Obituary

PROF ERWIN BAUR

BY the sudden death of Prof Erwin Baur at the early age of fifty-eight years the science of genetics, and particularly plant breeding, has lost one of its foremost exponents. Having gone to Berlin to give an address at Harnack House on December 2 in commemoration of Correns, whose death was recorded only a year ago, he was suddenly struck down with angina pectoris and died within a few hours

Baur was born in 1875 at Ichenheim in Baden, the son of an apothecary He studied medicine in several German universities and was for one year assistant in the Botanical Institute at Kiel, receiving the degree of doctor of medicine in 1900 He served as ship's doctor on a voyage to Brazil, followed by a year of service in the navy He was afterwards assistant physician in the psychiatric clinic of the University of Keil and physician to an institute in Baden for the insane In 1903 he returned to botany and received the Ph D at Freiburg under Oltmanns, his thesis being on the development of the apothecia in lichens Apparently his first botanical paper was on the sex organs of the lichen *Collema* (*Ber deut bot Gesells*, 16, 1899), the figures from which have frequently been reproduced in textbooks Baur now migrated to Berlin as assistant in botany, where he became full professor and director of the Botanical Institute of the Königliche Landwirtschaftliche Hochschule in 1911

The rest of Baur's life was not only actively devoted to research in plant genetics and its applications (except for the last two years of the War, when he was transferred to Potsdam with his staff), but also in this period he founded and directed successively a new Institut fur Vererbungslehre in Berlin-Dahlem in 1922 and a still larger Kaiser Wilhelm Institut fur Zuchtungsforschung at Muncheberg, some distance from Berlin, in 1929

Erwin Baur was a man of tremendous energy and vigour, but overwork brought his life to an all too early end His well-known genetical investigations of *Antirrhinum* were begun about 1904, and already in 1910 he was growing some 30,000 antirrhinums a year. He also made the early studies of infectious chlorosis in Malvaceæ, *Ligustrum*, *Fraxinus* and other plants, and his investigations of graft hybrids and chimæras in *Pelargonium* and other plants were notable His "Einführung in die experimentelle Vererbungslehre", first published in 1911, has passed through eleven editions, and fulfilled somewhat the same functions in Germany that Bateson's well-known "Mendel's Principles of Heredity" did in England

In a series of classical researches, Baur first investigated the large number of colour factors and other mutational differences in the garden snapdragons Later his interest in the evolutionary aspects of the genus developed He collected and studied the wild species of *Antirrhinum* from Spain and other Mediterranean countries, finding throughout the genus that the specific differences behaved as Mendelian characters in crosses At the Muncheberg Laboratory the same genus was extensively used by Baur, Stubbe and other colleagues in the production of an extraordinary series of mutations in flower and leaf form by the use of X-rays, ultra-violet light, temperature shocks and a wide range of chemical substances These substances were forced into the leaves through the stomata by centrifuging seedlings which were inverted in tubes containing the solutions The plants were then set out and allowed to flower Baur's great knowledge of the wild forms of *Antirrhinum*, their distribution and genetics, will unfortunately be lost, as it had not been put in a form for publication

Baur's interests lay not only in the wider aspects of genetics but also in their application. This was exemplified in the Masters Lectures of the Royal Horticultural Society, which he gave in 1931 His general evolutionary outlook was that of Darwinian natural selection based on mutational variations, but the aims of the Muncheberg Institution were immediately economic Baur set about to produce a wheat suitable for light soils in Germany in place of rye, by crossing and selection on a huge scale By the testing of one and a half million lupins, plants were found in both the yellow and the blue species which were devoid of alkaloid and could be propagated as a forage field-crop. By similar large-scale selection a variety of *Melilotus alba* was obtained free from cumarin, and a tobacco free from nicotin. Efforts were being made to produce a grape which was resistant to *Phylloxera* and *Peronospora*, by extensive crossing with North American varieties and subsequent selection. Baur visited Peru and Bolivia, bringing back many native varieties of potato for use in plant breeding. Other large-scale crosses were made for the improvement of gooseberries, raspberries, blackberries and tomatoes.

In 1908, Baur founded and edited the *Zeitschrift fur induktive Abstammungs- und Vererbungslehre*, which has remained one of the standard journals for genetical researches and publishes a comprehensive classified bibliography of the world literature. He also founded the *Bibliotheca Genetica*, *Der Züchter*, and was joint editor of the *Zeitschrift fur Pflanzenzuchtung Gartenbauwissenschaft* and *Berichte uber die gesamte wissenschaftliche Biologie*. With Dr. M. Hartmann he had produced since 1928 the "Handbuch für Vererbungswissenschaft". He was thus instrumental in giving publication to a very large amount of important genetical work. Baur, with Fischer and Lenz, wrote the well-known "Menschliche Erblichkeitslehre und Rassenhygiene", which has seen several editions At the fifth International Congress of Genetics, held at Berlin in 1927, he was a leading spirit and gave the opening address as president of the local committee.

Prof Baur was an honorary member of many scientific societies and was elected a foreign member of the Linnean Society of London in 1933 An indefatigable worker, his results have been among the most fruitful in modern plant genetics R. RUGGLES GATES

PROF W. E. GIBBS

IT is with great regret that we record the death on January 18 of Prof. William Edward Gibbs, at the early age of forty-four years. Prof Gibbs was the Ramsay professor of chemical engineering at University College, London, having been appointed to that post on the resignation in 1928 of Prof E C Williams At the time of his appointment a large extension of the Department of Chemical Engineering had been planned, as the result of generous donations from various important British chemical firms, obtained through the energetic propaganda of his predecessor The extension was designed and carried out by Prof. Gibbs with conspicuous ability and success, and within a few years his genial personality, combined with his deep interest in research, his organising power and his practical knowledge of industrial methods and processes, had filled the much enlarged laboratory with a band of enthusiastic students drawn from many sources—young British university graduates, experienced men from various industries, and foreign students.

Prof. Gibbs was a graduate of the University of Liverpool, and obtained his first post as assistant chemist to the Straits Trading Company at Singapore. Having held this post for a few years, he returned to the University of Liverpool, and the present writer recollects the enthusiasm with which he attacked the problem of the electrochemical recovery of metallic tin from the waste smelter material which he had brought home with him. At Liverpool he was soon appointed lecturer in metallurgy, and he was also made investigator to the Corrosion Committee of the Institute of Metals.

During the War, Prof. Gibbs rendered valuable service to the country, holding successively the posts of chief examiner of the Aeronautical Inspection Department, and chief chemist to the Government Rolling Mills at Southampton At the conclusion of the War he was appointed chief chemist to the Salt Union, a post which he held until appointed professor at University College. During this period he acquired an extensive practical acquaintance with the technical methods and problems relating to evaporation and crystallisation

Prof. Gibbs was deeply interested in the properties and treatment of aerosols and aerogels, that is, disperse systems in gases, and wrote two excellent books, "Clouds and Smokes", and "The Dust Hazard in Industry", which are, so far as the present writer is aware, the first scientific expositions of these important subjects in book form in the English language He was also very much interested in problems relating to heat exchange, the flow of liquids and gases, the fractional distillation of liquid mixtures and the design of gas-scrubbers and rectifying columns. In these and other fields of chemical engineering he understood well how to combine the theoretical basis of design with the practical aspects of construction and operation, and he possessed the supreme gift of awakening and sustaining the intelligent interest of his students and securing their loyal and indeed affectionate co-operation.

Prof Gibbs was a man of high, unselfish and sterling character, combined with an endearing charm and simplicity of personality not often encountered in this world His untimely death is a severe loss, not only to his colleagues and students at University College, but also to the Institution of Chemical Engineers and the science and practice of chemical engineering throughout the world F. G D

DR. HERMANN CHRIST-SOCIN

BARELY three weeks before his hundredth birthday, and still fully in possession of his physical and mental faculties, Dr. Hermann Christ, the Nestor of European botanists, had the misfortune to slip on the polished floor of his study and to fracture his leg. Unfortunately, too, complications set in and he died on November 24 at his home in Riehen near Basle.

Though known throughout the world as a botanist, Dr. Christ was by profession a lawyer, for which career he prepared himself by studies in the Universities of Basle and Berlin. But, interested since his boyhood in natural history, Dr Christ took the opportunity while in Berlin to attend the excursions of Prof Alexander Braun, and his natural inclinations were greatly stimulated by his intercourse with that eminent botanist In his reminiscences, written on the occasion of his ninetieth birthday, Dr Christ relates with what great interest he read von Humboldt's works on the geographical distribution of plants, and on returning to Basle, he began to devote himself to this field of botany, publishing several short papers on special aspects of the flora of Switzerland, the substance of which he gathered together with further observations in his "Pflanzenleben der Schweiz" published in 1879

Dr Christ's interest in systematic botany was equally keen and his legal training seemed, as has been the case with other eminent botanists, to be of distinct help to him in sifting scientific evidence He occupied himself with the difficult genus *Rosa* on which he published his account of "Die Rosen der Schweiz" in 1873, and sixty years later, in his hundredth year, he published a further paper on this favourite subject of his dealing with the roses of the Canton Valais Other contributions to systematic botany dealt with the European conifers and with the European sedges, another difficult genus But it is with the group of ferns that Dr Christ's name will remain most closely associated The Ferns of Switzerland", "The Ferns of the World" and the "Geographical Distribution of Ferns" are three standard works which will always be consulted by pteridologists His industry as a botanist can be gauged from the fact that his botanical publications amount to more than three hundred and these were written during the time he could spare from his many professional activities as a lawyer, for he held an important legal post in connexion with the Swiss railways

Neither scientific nor professional preoccupations dimmed Dr Christ's humanitarian feelings, and on the occasion of the revelation of the Congo atrocities, he joined with Morel in organising the universal protest against the cruelties of the slave trade in Africa, and was one of the founders of the Swiss league for the protection of the natives in the Congo State

The influence of a man of such wide interests and insatiable activity carried on during an exceptionally long life has been felt far beyond the limits of his beloved town and country, and his untimely death, as one may call his passing away so near to the completion of his centenary anniversary, will be mourned by all his admirers, who will however keep him and his labours in grateful remembrance

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WE regret to announce the following deaths

Dr Lilian J Clarke for several years head science mistress at James Allen's Girls' School, Dulwich, and member of many committees on the teaching of biology on February 12 aged sixty-eight years

Dr D W Freshfield, president of the Royal Geographical Society in 1914–17, of Section E (Geography) of the British Association in 1904, and of the Association of Geographical Teachers in 1897–1910, on February 9, aged eighty eight years

Dr Bernard Hollander, a well known authority on diseases of the nervous system, and author of books on psychology eugenics, and related subjects, on February 6, aged sixty nine years

Sir Lionel Jacob, K C S I , chief engineer and secretary to the Government of Burma in 1903–5 , inspector general of irrigation and secretary, Government of India (Public Works Department) in 1905–11 on February 9 aged eighty years

News and Views

Evolution of the Mind

WITH his customary lucidity, Prof Elliot Smith has presented, in the Royal Institution discourse which accompanies this issue of NATURE as a special supplement, an account of the present position of his researches in organic neurology in conjunction with the results of other workers, particularly Campion and Le Gros Clark The result is not only a notable step forwards towards an understanding of the complex temporo spatial relationships which from one point of view are designated the brain and its related mechanisms, and from another mental function, but it is also an effective counterblast to recent efforts prematurely to recrystallise Sir Henry Head's outstanding contribution to our understanding of sensory integration in forms of merely clinical application It is to be hoped that the danger to true progress in neurology resident in these efforts has been, if not averted, at all events withstood for the time being Poljak's demonstration that even in the simplest act of thought or skill the whole neopallium must participate reinforces the question, in respect of localisation'—the concern of clinicians—localisation of what ? The present contribution emphasises again the integrity of the brain as a whole as the effective instrument of a biological objective in action rather than in thought It may be said that with each advance in the evolutionary scale as well as in our understanding, the number of the neurological constituents of action is seen to increase

IT is not only that for the acquisition of the characteristic modes of the human *mind* a cognitive is added to an affective experience and to both is added a conative experience , but also for the development of the characteristic functions of the human *brain* a subtler progression eventuates, having little regard or none for these concepts of the schools In his most recent revelation of the stages of this progression, Prof Elliot Smith deals with those truly neurological 'bricks', the thalamus and the hypothalamus, the seats respectively of emotional formulation and effective expression, in the light of their special linkages with the cortex itself, facilitating a "cortico thalamic circulation" which finds functional expression in an enrichment of concepts by the gains of experience of failure or success in past action. While this broadening of the issues involved in what is now known of the fibre relationships of the cortical and thalamic organs is the outstanding feature of Prof Elliot Smith's lecture, a paragraph—all too brief—must not be overlooked which records the evident complexity of the neural machinery of the parts involved and proceeds to assert that "it becomes essential to look at the whole issue from a much broader point of view than the mere connexions of thalamus and cerebral cortex". The 'key' word of the sentence is 'connexions' and 'mere' is there to turn it vigorously Is it justifiable to hope that the self-sufficiency of the neurone is at last to be called in question and that the truly organic character of the brain may be substantiated 'in our time'? Is this not a case where the answer has long been prepared and only awaits the application of the question to reveal its fruitfulness?

Sir George Buchanan, C.B

By the retirement of Sir George Buchanan on February 18 from his post as senior medical officer of the Ministry of Health, an association with the public health of Great Britain of nearly forty years is terminated, for Sir George was appointed a medical inspector of the old Local Government Board in 1895 During this period he has accomplished much valuable work over the whole range of public health In early days he dealt with infectious disease outbreaks, questions of water supply and sewage disposal, housing problems and slum clearance During the five years 1906–11, he acted as chief inspector of foods, and afterwards was the chief assistant medical officer of the Local Government Board, becoming on the formation of the Ministry of Health its senior medical officer On the outbreak of War in 1914, Sir George was immediately attached to the Army Sanitary Committee and served on the eastern fronts at Gallipoli and in Macedonia and Mesopotamia, though little mention of the services he rendered there will be found in official records With the cessation of hostilities commenced his association with the League of Nations He had been a member of the Health Committee of the League from its foundation, and now became its vice-president, and he also became British representative of the Office International d'Hygiene Publique In 1919 he was a member of the Poland Typhus Commission instituted by the League of Red Cross Societies, was appointed president of the League of Nations Cancer Commission, and was a member of the League's mission for the public health reorganisation of Greece. In 1926, Sir George was appointed chief British delegate to the International Sanitary Conference. During the last twelve years he has assisted at numerous Government and official investigations This bare outline of Sir George Buchanan's activities during his official career suffices to show that he has played a part for which he has earned his country's gratitude

Dr. Thomas C. Porter

By the death of Dr Thomas Porter, for many years science master at Eton College and one of the founders of the (Public Schools) Science Masters' Association, on March 31, aged seventy-three years (Nature, 131, 496, April 8, 1933), science teaching in Great Britain suffered a severe loss An obituary article in the *Journal of the Chemical Society* of December 31 stresses Dr. Porter's influence as a teacher Though he was gifted with remarkable talent, he never allowed himself to specialise This wide range of interests was the source of inspiration which many of his pupils gained from him Porter was born at Bristol and was educated at the Grammar School, from which he gained a scholarship in natural science at Exeter College, Oxford, in 1878 In 1885 he was appointed at Eton, and there he taught for forty-eight years He was responsible for many improvements and extensions in the teaching of science at the College Dr Porter's own investigations covered a wide field. His most serious contribution was on the phenomenon of 'flicker', contributed to the *Proceedings of the Royal Society* in 1898, 1902 and 1912 He was the first to notice the non-homogeneity of X-rays (Nature, 54, 149, June 18, 1896) Papers on Newton's rings and the use of flames for enhancing the intensity of sound were published in the *Philosophical Magazine*

British Industries Fair

It has become almost a stereotyped phrase to say of each British Industries Fair that it is larger and more representative than any that have preceded it. The twentieth British Industries Fair to be held in London and Birmingham on February 19–March 2 maintains this tradition In the London Section the lighter trades and Empire exhibits will be found at Olympia, while the textiles and clothing and the furniture displays will be at the White City. The Birmingham Section at Castle Bromwich comprises hardware, house equipment, engineering and 'heavy' industries generally At Castle Bromwich there will also be an out-of-doors exhibition for the display and demonstration of agricultural implements, light railways, and quarrying and road-making plant. The trade groups which have shown the most marked growth, judged by the extent of their exhibits at the Fair, are furniture (the biggest section in the Fair) at the White City, electricity and building at Castle Bromwich, and the following groups at Olympia: Government of India, brush-ware and fancy goods; jewellery, pottery and glass-ware, sports goods; stationery, printing and office equipment, etc.; toys and games; chemicals and druggists' sundries It is interesting to note that the first British Industries Fair, which began as a War-time experiment in 1915, consisted of about 5 miles of stands at the Royal Agricultural Hall, Islington, whereas the stands of this twentieth Fair, in 1934, extend to about 32 miles or, say, fifteen times the length of Oxford Street. Incidentally, it may be noted that twenty-two Continental countries—another record—have given special travel concessions this year to encourage attendance at the Fair by their trades buyers. In these days of quotas and other forms of restrictions on international trade, it is very significant that twenty-two Continental countries should so appreciate the international importance of the British Industries Fair.

Sale of Contraceptives

ON February 13, Lord Dawson of Penn moved the second reading of the Contraceptives Bill. The provisions of the Bill were dealt with in a leading article in NATURE of February 10, p. 192. Lord Dawson said that birth control is now "part and parcel of our social fabric" and that he wished to identify himself with the view that the way to keep the sale and use of contraceptives on sound lines is "to remove the veil of doubt as to the honesty of contraception". Birth control is already accepted in practice, and if there were only wider acceptance of it in theory, the sale of contraceptives would go into normal channels. Meanwhile, he is of opinion that children and young persons require a certain amount of protection such as the bill would afford. Lord Dawson said that he is quite prepared to accept amendments provided that the principle of the bill is not undermined. The Bishop of London, while not agreeing with Lord Dawson, said he would support the Bill enthusiastically, giving as his reason the moral effect of the indiscriminate advertisement and sale of contraceptives. The Archbishop of Canterbury supported the Bill as being a serious attempt to check in some measure the growth of an evil which is poisoning the moral health, self-control and self-respect of the community. The motion for the rejection was negatived by 45 votes to 6.

Tree-Kangaroos

THE birth of a tree-kangaroo at the Gardens of the Zoological Society of London is an event well worth recording. Another was born at about this time last year. One would have supposed that the drastic change from the tropical forests of New Guinea and North Australia to a relatively small cage in London would have inhibited the reproductive activities. Even without this added interest, the presence of this strange creature in the Gardens is something more than welcome to all who are concerned with the problems presented by anomalous changes of habit and habitat in the animal kingdom. The typical kangaroo is, in itself, a sufficiently remarkable animal. For here we seem to have a convincing example of 'neo-Lamarckian' changes of form. Though how the initial stage of the leaping habit began we are scarcely likely to discover. It is not merely that the hind-legs and tail have grown inordinately large, but we have also to take into account the quite unusual nature of the reduction of the toes; for instead of disappearing on each side of a median axis, the reduction of the second and third toes has taken place on the inner side of the foot, where the claws only are visible in the living animal.

IT seems clear that the tree-kangaroo must have taken to an arboreal life after this specialisation for terrestrial leaping had taken place; though it is to be noted that, as in the wallabys, the hind-legs are shorter, and the fore-legs relatively larger than in the large ground dwellers of the tribe. Unfortunately, the opportunity of witnessing the actual birth of any of these animals occurs only on the rarest occasions, and it would seem that even then it is by no means easy to interpret what is seen. It used to be believed that the mother seized the infant at the moment of birth in her lips, and immediately transferred it to the teat in her pouch, to which it attached itself forthwith, and retained its hold continuously for some weeks while its further development took place. For the young, in the kangaroos, are, so to speak, prematurely born, with the limbs only slightly developed. A later account gives a very different version, embracing an astonishing degree of activity on the part of this almost embryonic little body. For it is said to make its way up the fur of the parent and into the pouch, and to find the teat unaided, a course of behaviour one would have deemed impossible.

Emigration Schemes in Australia

IN an article in NATURE of November 4 on population problems, reference was made to the failure of emigration for the time being. Commenting on the position, so far as Australia is concerned, Sir James Barrett, of Melbourne, in a letter to the Editor, states that the failure is not so disastrous in Australia as appears on the surface, despite the fact that, in Victoria alone, many millions of pounds will be lost on land settlement schemes. Few people realise that industrial farming requires for success scientific knowledge and training at least equal to that required in any learned profession. In his paper read before the World Population Conference in 1931 the late Prof. J. W. Gregory showed the importance of immigration to Australia in order that a population capable of making the utmost use of railways, etc., should be established in that country as quickly as possible. In Victoria more than £10,000,000 has been spent on irrigation works which, together with railways, were planned in accordance with a far-seeing land settlement policy. In addition, therefore, to the actual cost of land settlement schemes which the taxpayer, as Sir James Barrett says, is now forced to meet, there is this further heavy expenditure, much of which has been incurred directly for immigration and land settlement. Prof. Gregory also made some interesting references to the varying estimates that have from time to time been drawn up as to Australia's capacity for supporting a large population. These range very widely, from about 200,000,000 estimated by Admiral Sir Edmond Slade to about 10,000,000 and other similar low estimates made in Australia itself, for example, by F. C. Benham of the University of Sydney. Prof. Gregory's own estimate was more nearly 100,000,000.

Lord Bledisloe and the Promotion of Science

LORD BLEDISLOE, the Governor-General of New Zealand, has consistently encouraged scientific workers in the Dominion, and has promoted endeavours in all branches of science. As evidence of his keen scientific interest, during the visit of the Byrd Expedition II to Wellington on December 9, Lord Bledisloe promoted a happy scientific colloquium at Government House, when the visiting explorers were entertained along with the permanent scientific workers of the Dominion It is more than twenty years since so large a number of men belonging to different nationalities, whose researches are outstanding in different branches of science, have been gathered around one table in New Zealand The function allowed group discussions of all branches of the scientific work of the Expedition, which is probably provided with a larger scientific staff, and has a more extended scientific programme, than any expedition which has so far visited the antarctic Of outstanding interest is the work projected in cosmic ray determinations, and it is understood that the results on the trip from the United States have verified A H Compton's results in the variation with latitude of cosmic ray intensity The results of observations in the neighbourhood of the magnetic pole and on the polar plateau will be awaited with interest

The Byrd Antarctic Expedition

AMONG the interesting items in the programme of work of the Byrd Antarctic Expedition are the use of seismic reflection methods for the determinations of ice thickness and depth For this work, the expedition is well equipped with the latest types of apparatus Close attention will be devoted to upper air observations as forming a very considerable part of the extensive meteorological research programme which has been outlined The expedition is also proposing to take the fullest advantage of the opportunities afforded in this region for studying polar aurora. The biological and geological problems associated with Antarctica will also receive close study, and the scientific world should be considerably richer as the result of the labours of the staff of the Byrd Expedition II in the south polar regions

WE regret that news of the Expedition up to the end of January was not of a wholly reassuring nature. According to the *Times*, the larger of the two vessels of the expedition, *Jacob Ruppert*, was caught in the pack-ice and drifting in the Ross Sea. Apparently the ship had met with much difficulty on account of ice but had reached the proximity of the Ross Barrier by January 27; it began to discharge cargo on to the ice whence it was to be sledged by dogs and tractor to the base at Little America on the Bay of Whales. The following day, however, rifts appeared in the ice and several drums of petrol were saved with difficulty. The ship had to cast off, leaving a large party of men on the ice. The time now available for landing supplies is short since the ice is likely to freeze together at any time now, thus endangering the safety of the ship or at least its chance of getting away before the winter sets in.

Research and the Electrical Industry

THE thirteenth annual report of the British Electrical and Allied Industries Research Association for the year ended September 1933 gives an interesting résumé of the many problems on which it is engaged. In a foreword, Mr. C. C. Paterson, the chairman of the Council, says that the electrical industry has been built up by research, and by research only can it continue to prosper. This research must be made on a scale commensurate with its growth. Some of the researches described have a longer outlook than others, but none of the researches can be abandoned or even delayed without definite loss to the industry as a whole Much of the work done is in co-operation with other organisations. It is a pity that a number of large authorised electrical undertakings have not yet seen their way to become full subscribing members. The subscription assessment agreed to, at a recent conference, was £10 per £25,000 of revenue It is certainly not onerous. Research has often the effect of appreciably, and sometimes largely, reducing capital and working costs and hence non-subscribers are benefiting from work, the cost of which has been borne by others. The High Commissioners in London for the Dominions and Colonies have shown an active interest in the work of the Association, particularly the Indian Government Applications for membership have been received from several local State Governments and Public Works Departments We are glad to hear that the Association is taking an active part in locating the causes of radio interference. The solution of these urgent problems has involved sacrifices by the staff. They have been able to mobilise a squadron for field work and a mobile laboratory at short notice and are obtaining useful information

Industrial Health in Japan

IN Japan the pressure of a growing population has focused attention on the further development of industry, since in the next decade Japan has to find food and employment for nearly ten million more people than she does to-day. That the problem of industrial efficiency is being seriously tackled is evidenced in the annual report of the Director of the Japanese Institute of the Science of Labour at Kurasiki. This Institute was founded some years ago to undertake research into the physiological, psychological and environmental conditions affecting workers and their output. Research committees have recently been organised to investigate problems such as the rationalisation of labour, industrial fatigue, factory conditions and the appropriate qualifications to be desired of workers in every branch of Japanese industrial life. This latter investigation has already led to the establishment of standard norms for the mental and physical development of young Japanese workers aged 12–20 years. Occupational diseases

(*Continued on p. 253.*)

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Evolution of the Mind*

By PROF. G ELLIOT SMITH, F R S.

IT may be asked by what right an anatomist, whose proper business is concerned with very concrete subjects, presumes to discuss so elusive and immaterial a subject as the evolution of the mind even if it be admitted that the evolution of the chief organ of the mind comes within the proper scope of his field of work I am encouraged, however, to embark on this hazardous attempt by the considered judgment of Prof S Alexander, who once expressed the opinion "that we are forced to go beyond the mere correlation of the mental with [the] neural processes and to identify them"

The great physiologist who is most competent to express an opinion on this issue has recently impressed upon us the need for caution in touching it In the closing passage of his Rede Lecture on "The Brain and Its Mechanism", delivered in Cambridge on December 5, 1933, Sir Charles Sherrington used these words "I reflect with apprehension that a great subject can revenge itself shrewdly for being too hastily touched To the question of the relation between brain and mind the answer given by a physiologist sixty years ago was 'ignorabimus' But to-day less than yesterday do we think the definite limits of exploration yet attained The problem I have so grossly touched has one virtue at least, it will long offer to those who pursue it the comfort that to journey is better than to arrive, but that comfort assumes arrival Some of us—perhaps because we are too old—or is it too young ?—think there may be arrival at last " These opinions are even more appropriate to those who lack Sir Charles Sherrington's immense competence

Hence I seize upon a confession made by Sir Charles elsewhere in his Rede Lecture

"What right have we to conjoin mental experience with physiological ? No scientific right', only the right of what Keats, with that superlative Shakespearean gift of his, dubbed 'busy common sense' The right which practical life, naïve and shrewd, often exercises "

If scientific proof, however, is demanded, surely Sir Henry Head's investigation of sensation and the cerebral cortex supplies it by demonstrating in wounded soldiers the concern of the cortex with psychical functions—the dependence of mind on brain ("Studies in Neurology", 1920) Prof Shaw Bolton, by comparative and clinico-pathological researches, has demonstrated the dependence of mind on the supragranular layer of the cerebral cortex

With these assurances the mere biologist, while discussing strictly biological issues, can direct attention to certain psychological implications of anatomical facts and comment also on their neurological aspects for the interpretation of the mind and its working In previous lectures at the Royal Institution I have discussed the significance of the heightened powers of vision in man's ancestors, which conferred upon them the ability to see the world in which they were living and appreciate something of what was happening in it, as well as to guide their hands to acquire skill, by the practice of which fresh knowledge and understanding were obtained

SIGNIFICANCE OF VISUAL GUIDANCE

We know enough of the comparative anatomy and palæontology of the Primates to select a series of animals that can be taken to represent approximately the stages through which man's ancestors passed in their evolution towards man's estate, and by examining the connexions of the optic tracts in the brain, arrive at an understanding of what is involved in the acquisition of higher powers of visual discrimination (Fig 1)

In this series of diagrams, it will be observed that at first the areas for touch, vision and hearing come into contact with one another but that eventually an area marked *P* (parietal association area) develops between them to provide a more efficient place of blending of the impulses from these three senses At the same time there emerges from the front end of the brain a prefrontal area (*F*) which is essentially an outgrowth of the motor territory and an instrument whereby the activities of the whole cortex can in some way be concentrated on the process of learning to give motor expression to the total activities of the hemisphere Certain poisons which exert a destructive influence on the supragranular layer of this part of the cortex lead to very significant mental results, such as are displayed in general paralysis of the insane, characterised at first by grandiose delusions and afterwards by a failure of the mental process altogether, profound dementia The discussion of this evidence by Dr J Shaw Bolton ("The Brain in Health and Disease", 1914) affords another precise demonstration of the dependence of the mind upon particular parts of the brain

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* Friday evening discourse delivered at the Royal Institution on Jan 19

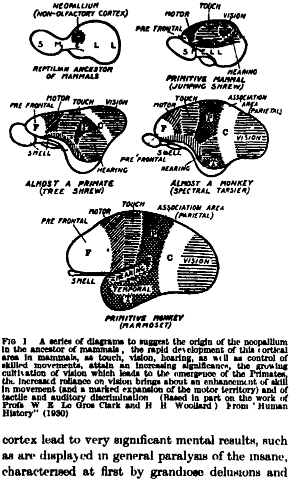

FIG 1 A series of diagrams to suggest the origin of the neopallium in the ancestor of mammals, the rapid development of this cortical area in mammals, as touch, vision, hearing, as well as control of skilled movements, attain an increasing significance, the growing cultivation of vision which leads to the emergence of the Primates, the increased reliance on vision brings about an enhancement of skill in movement (and a marked expansion of the motor territory) and of tactile and auditory discrimination (Based in part on the work of Profs W E Le Gros Clark and H H Woollard) From "Human History" (1930)

This is an example of the means whereby comparative anatomy can throw light upon the process of mental evolution, the structural changes in the eyes and brain which make possible not only the refinement of visual discrimination, but also the increasing participation of visual perception in the conscious life and in the guidance of the instruments (such as the hands) of muscular skill The latter consideration is one of fundamental importance For the study of the evolution of the nervous system impresses upon us the fact that one of its essential purposes is to make possible quicker, more complex and more purposive responses to changes in the animal's environment or the conditions in its own body

It is a matter of real importance, therefore, that every advance in the powers of sensory perception and discrimination should be brought into relationship with this essential biological need of finding expression in action Each of the major advances in vertebrate evolution is obviously correlated with differences in locomotion and muscular aptitude When an amphibian emerged from a fish-like ancestor, the most obtrusive change was the substitution for swimming as a means of locomotion, the use of the newly-created 'gadgets' which are represented by the limbs of a tetrapod land-living animal The attainment of greater competence and agility in the control of the amphibian's four legs led to the emergence of reptiles, from which in course of time birds and mammals were evolved, the former by high specialisation of the forelimbs by flight, and the latter by the acquisition of a cerebral instrument, the neopallium, which conferred the ability to attain unlimited powers of acquiring skill and to profit from experience The highest powers of skill were made possible by the evolution of greater powers of visual guidance

It is an obvious truism that man's mental superiority is largely the outcome of the perfection of the co-operation of hand and eye in the attainment of manipulative skill and dexterity In the use of the hands for the expression of skill, the skin of the fingers acquires heightened powers of tactile discrimination, and thus becomes the special organ of the sense of touch and an instrument of perceptual knowledge second only to the eyes in significance

The researches of Sir Henry Head and his collaborators have given us a new understanding of what is involved in tactile discrimination The great sensory pathways in the spinal cord and brain-stem lead up to the thalamus in the fore-brain, where they end in its ventral nucleus, the nerve cells of which transmit impulses in two directions—one to the cerebral cortex and the other to what Sir Henry Head calls the essential organ of the thalamus The former is regarded by him as the mechanism for sensory discrimination, and the latter as the instrument for awareness to sensation and the appreciation of its affective qualities, its pleasantness or unpleasantness

HYPOTHESIS OF A THALAMO-CORTICAL CIRCULATION

In the *British Journal of Medical Psychology* in 1932, Mr George G Campion discussed the psychological implications of Head's clinical results Emphasising the impossibility of separating from perception the affective factor, which is continually at work in our thought-processes, Mr. Campion gave expression to the view that the biological purpose of giving a meaning to experience is the essence of the comprehension of the nature of sensation Mr Campion has emphasised the further fact that the concept—the ultimate constituent element of what are called our cognitive dispositions—is not fixed and unchangeable, but is "a living plastic mental symbol subject to a process of organic growth, and that its growth is due to an affective factor which is constantly at work determining the selection of new sense data from the perpetual flux, interpenetrating the conceptual contents of our minds, and integrating all these various and varying constituents into the slowly maturing dispositions which constitute organised knowledge The affective factor involved in this process has been variously called 'libido', 'love', 'interest', 'feeling', 'desire', 'liking', etc "

Mr Campion further maintains that there is a continuous stream of neural impulses from the thalamus to the cortex and from the cortex to the thalamus, which keeps alive this living process of mental growth—the enrichment of the concept as the result of personal experience, the success or failure of the attempts to do things

Developing this idea, Mr. Campion directs attention to the various parts of the cortex linked in an incredibly complicated way by association fibres and cortical association areas. The necessary implication of his hypothesis of the thalamo-cortical circulation of neural impulses (by means of the various thalamo-cortical and cortico-thalamic tracts of fibres), involves functional connexions of the various parts of the thalamus with one another by intercommunicating fibres. He predicts that as "the cortical association areas may be assumed to have a counterpart also in the thalami, it will be for neurologists to say whether these hypothetical association areas lie in and constitute a chief part of what Head has called the essential thalamic organs "

Since this prediction was made, Prof Le Gros Clark, in the course of studies (*Brain*, vol 55) in the comparative anatomy and physiology of the thalamus, has directed attention to the fact that such elements are actually found in the thalamus of the higher mammalia There are cell masses (lateral nucleus (Fig 3)) deriving their impulses from the main sensory part (ventral nucleus) of the thalamus, which merge sensory impulses of different kinds and establish direct connexions with those association areas of the cortex which link together the cortical sensory areas This remarkable confirmation of Mr Campion's hypothesis adds force to the argument that the mechanism of correlation in the thalamus is far more complicated than has hitherto been supposed, and represents what, following the lead of Sir Henry Head, one may suppose to be a mechanism for the integration of affective processes in the same way as the cortex effects the integration of the discriminative or cognitive aspects of experience

In the process of acquiring knowledge and building up these vital mental elements, the concepts, to which reference has already been made, it is obvious that there must be a circulation of nervous impulses such as Mr Campion assumes to maintain the cohesion and the integrity of the vital processes of thought This circulation of impulses must be even more complicated than he has assumed, because the hypothalamus undoubtedly enters into the process and influences the activities both of the thalamus and the cortex, adding as its quota the visceral element which confers upon experience an emotional factor which is something more than the affective interest the thalamus is able to provide Intimately intertwined with the whole of this complicated system —hypothalamus, thalamus and the sensory and association areas of the cortex—we have the complex mechanism for giving expression to their combined activities in actions which represent the biological purpose of the whole process. The powerful instrument of thought represented by speech affords an admirable illustration of the intimate correlation of muscular skill with cognitive aptitude to provide the essential currency of mind.

Almost every part of the cerebral cortex is intimately connected directly and indirectly with mechanisms in the central nervous system which are concerned with muscular activities, either those which directly effect movements, or on a vastly greater scale those which prepare and co-ordinate the state of the muscles of the whole body in readiness for prompt and efficient action. More than two-thirds of the fibres that leave the hemisphere have as their immediate purpose the establishment of connexions with the cerebellum, and as their function, the rapid distribution of the muscular tone of the body in readiness for such skilled action as lies at the root of the brain's efficiency. The circulation of the thalamic and cortical currents maintains this constant state of readiness and is a vital and essential part of consciousness and mind.

The building up in the brain of concepts is dependent not merely on affective and cognitive experience based upon afferent impulses from the sense organs, but is also brought about as the result of muscular activity, the doing things with the hands, the gradual perfecting of the movements, the results of the success or failure of such efforts, and the afferent impulses which pour into the brain from the joints, the muscles and the skin areas to record the success or failure of particular muscular activities. It is largely by doing things that experience is built up. It is important therefore to recognise the very large part which such conative activities play in the building up of concepts. They are due not merely to the interaction of the affective and cognitive dispositions, but also to the dynamic factor which is conferred upon these processes by attempting to express in action the result of the discriminative activities of the cortex.

THE NEOPALLIUM AS THE ESSENTIAL MENTAL INSTRUMENT

More than thirty years ago, I directed attention to the fact (*J. Anat. and Physiol.*, p. 431, 1901) that with the evolution of mammals a new cortical instrument, which I called the neopallium, came into existence, and with its expansion provoked the vastest revolution that ever occurred in the cerebral structure. It came into being to form a receptive organ for fibres coming from the thalamus, whereby touch, vision, hearing and taste—in fact all the non-olfactory senses—secured representation in the cerebral cortex. To express this fact, Prof. Winkler, of Utrecht, calls the neopallium the thalamocortex.

In its earliest form the neopallium consists of a tiny area far forward in the hemisphere, where tactile impulses from the lips and tongue are brought into relationship with olfactory and gustatory impulses, and this area afterwards acquires the ability to control the movements of the lips and tongue. As the neopallium grows it establishes similar relations to the rest of the body and increases the range of its receptive powers not merely to the skin of the whole body, but also to the eyes and ears, and it establishes direct connexions with all the motor nuclei in the central nervous system. The neopallium not only gives the senses other than smell representation in the dominant part of the brain and a part in the control of behaviour, but it also provides a continuous territory in which co-operation between these various sensory influences can be established and their conjoint effects be brought to bear upon the mechanisms that control motor activities.

It is often supposed that there are in the cerebral cortex long association bundles to establish connexions between distant parts of the cerebral cortex. There has recently been published an important memoir by Dr. Stephan Poljak, a Jugoslav neurologist who began the research in question in my laboratory eight years ago, which disproves the existence of such long connexions. An impulse from one cortical area can only reach and influence distant areas by travelling through the cortex itself. The act of correlation involves the whole cortex. Even in the simplest act of thought or skill, the whole neopallium participates. The manifold currents which circulate throughout the brain in the process of regulating muscular activities represent the means of integrating the cognitive, affective and curative activities in thought.

Not only the neopallium but also the brain as a whole adds its quota to the action—in particular the great mass of nervous matter at the threshold of the cerebral hemisphere known as the thalamus. It contributes the affective element, which is the interest, the stimulative of the whole complex process, to which it gives coherence. The cortex not only preserves the records of previous experience which provide the means for comparing present experiences with past happenings, but it also adds the spatial quality to sensation and the means of judging degrees of stimulation, and the afferent impulses which pour into the brain from the joints, the muscles and the skin areas, to record the success or failure of particular muscular activities It is by doing things that experience is built up. It is important therefore to recognise the very large part which such conative activities play in the building up of concepts They are due not merely to the interaction of the affective and cognitive dispositions, but also to the dynamic factor which is conferred upon these processes by attempting to express in action the result of the discriminative activities of the cortex

For some years I have been attempting to demonstrate how vast a part the cultivation of visual discrimination has played, not simply in making it possible for human beings to see the world in which they live and appreciate some of the activities which are revealed to them by their eyes, but even more in contributing to conscious control of behaviour.

The earliest type of cerebral cortex necessarily has to perform both affective and cognitive functions It enables its possessor to appreciate the attractiveness or unattractiveness of a particular scent, and to experience an interest in addition to the cognitive recognition of it

The cortex, at first, however, exercises no immediate direction over the motor activities of the animal beyond provoking them and providing the initiative to action This it accomplishes by transmitting to a mass of grey matter in its base (the corpus striatum) impulses which indirectly throw other parts of the brain and spinal cord into action to direct the movements that it starts It is the impulses from the eyes, skin and "ears" (as yet organs not of hearing, but of recording movements in the water) which consciously direct the animal's movements, while its posture and equilibrium are being maintained by the automatic mechanism of the membranous labyrinth

The tracts in the brain which convey the impulses from skin, eyes and ears are mainly concerned with transmitting to the various motor nuclei impulses that unconsciously influence and direct reflex movements, but they all send some of their impulses to a mass of grey matter in the forebrain, which lies immediately behind the striatum, to which it is intimately linked by many nerve fibres This is the thalamus (Fig 2) It confers upon all the non-olefactory sensory impulses an affective quality which gives them a meaning and an influence in modifying behaviour In other words, the effects of this sensory experience, when transmitted to the striatum, are to alter the animal's reactions to smell

EMOTIONAL FACTOR IN MIND

The activities of the striatum, when stimulated by the cerebral hemispheres and the thalamus, are expressed in impulses which proceed from it to the hypothalamus, a mass of grey matter lying beneath the thalamus This surprising arrangement seems to confer upon the hypothalamus the decisive influence in translating into behaviour the initiative to action which lies in the cerebral cortex The hypothalamus is the part of the brain which controls, by means of the sympathetic and parasympathetic systems, the most vital activities of the body itself, its visceral functions, its growth and metabolism, and even such appetites as those of sex It is the essential instrument of emotional expression

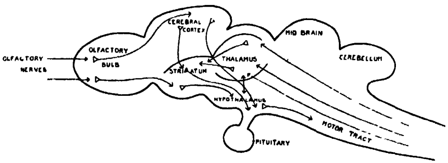

FIG 2 Diagram of the primitive vertebrate brain to suggest the hypothalamic, thalamic, striatal and cortical connexions

As the springs of action are profoundly influenced by hunger, thirst, sexual desire and other appetites and cravings, it is perhaps not surprising that in the most primitive vertebrates the instrument of the animal's vegetative needs should play a crucial part in shaping its conduct To this part of the brain, impulses proceed from the olfactory tracts so as directly to control the activities of the alimentary and genital systems in anticipation of the realisation of the satisfaction of the respective appetites

The study of the primitive brain impresses upon us the intimacy of the integration of the functions concerned with affective and discriminative knowledge and the translation of such information into appropriate action.

The higher type of brain distinctive of mammals, which opens up the possibility of the attainment of real conceptual knowledge and its biological application in increasingly complex acts of skill and thought, is distinguished by the growth of the thalamus and the transmission from it to the cerebral cortex of fibres in increasing numbers (Fig 3)

The recent progress in our knowledge of the structure and connexions of the thalamus and hypothalamus with the cerebral cortex, the hypothalamus and the sympathetic and visceral tracts of the organism had made it possible to carry Mr Campion's suggestions a stage further than he himself has done That this is possible is in large measure due to the illuminating researches of Prof W E Le Gros Clark The intensive studies which have recently been made by scores of investigators on the structure and connexions of the hypothalamus enable us to broaden the issues and consider the part played by these portions of the brain, which control the growth and metabolism of the body, and in particular visceral function, and how they are related to the thalamus and the cerebral cortex and provide the instrument for determining the emotional colour of experience and of regulating the manifestations of the appetites

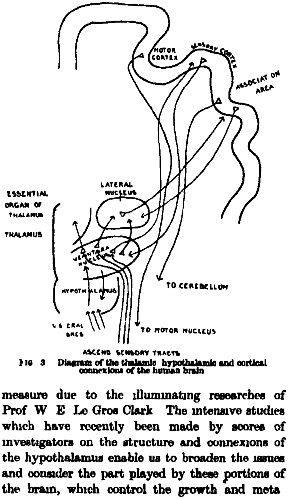

FIG 3 Diagram of the thalamic hypothalamic and cortical connexions of the human brain

If Mr Campion's views are correct, that the study of this neural machinery is essential for the understanding and interpretation of thought and behaviour, its structure and functions might be expected to be of great complexity Hence it becomes essential to look at the whole issue from a much broader point of view than the mere connexions of thalamus and cerebral cortex

IMPORTANCE OF SMELL IN THE PRIMITIVE VERTEBRATE

In the brain of the most primitive vertebrate, the structural pattern is determined by the fact that smell is the dominant sense The cerebral cortex is essentially a receptive instrument for impressions of smell, and the mechanism whereby consciousness of smell can influence the behaviour of the animal When a primitive vertebrate such as a dogfish scents attractive food and pursues it, the culmination of the pursuit is represented by the seizure of the food and the appreciation of its taste This is nearly akin to the initial olfactory experience which started the pursuit and dominated it, so that all the incidents of the pursuit become integrated into one experience, which is thus given coherence and meaning Thus is initiated the ability to anticipate the result of a given course of action, and to recall in memory the connexion between the various incidents

One must assume, therefore, that the primitive cortex is concerned not merely with the awareness of smell and the ability to discriminate between different kinds of smells, but also that it is concerned with the affective side of olfactory experience, with the attractiveness or repulsiveness of any scent and the influence of such affective experience in determining the nature of the response an individual odour can evoke The cerebral cortex in such a primitive animal is incapable of directing movements, seeing that the sense of smell is utterly devoid of any spatial quality When an animal scents an attractive food, it acquires from the sense of smell no idea as to the position in space of the object which provides the stimulus It is merely stirred into action, and other neural mechanisms are responsible for controlling and directing the resulting activities The cerebral cortex, so to speak, is the mere trigger which releases the activity of the brain and provokes and directs the movements

The part of the cerebral hemisphere which translates these stimuli into action is the corpus striatum, and the striatum is connected with the thalamus, which receives from the body, that is through the skin, the eyes and the ears as well as the muscles and joints, impulses which modify and direct movements which result when the animal is thrown into action. The thalamus transmits the effects of these stimuli to the striatum and so modifies the motor activities. In the case of organs such as the eyes, the primary functions were concerned not merely with the awareness of illumination, but also of movements in the outside world, or rather movements of objects in the outside world in reference in its own body The eyes have associated with them, in the brain, a complicated mechanism which enables them automatically to direct the movements of the body in relationship to events in the outside world. But quite apart from this, the eyes transmit to a part of the thalamus (the lateral geniculate body) impulses which are concerned with the awareness of the stimulus of light, and which influence these bodies and through them the thalamus as a whole, which in turn affects the functions of the striatum and the movements of the animal

In the primitive vertebrate one must assume that the thalamus acts as an affective organ of all senses other than smell, and represents the instrument whereby the organism is pleasantly or unpleasantly affected by sensory experience, and that the cerebral cortex performs the analogous but more dominating aspect of the same function in relationship with smell. The dominant part of the cerebral cortex in the most primitive vertebrate is the hippocampal formation, and if one assumes the supreme function of the cortex is to determine the behaviour of the animal, it is perhaps justifiable to assume that the purpose of the primitive hippocampus is to make possible the adequate association of the affective qualities of smell and to translate them into action by playing a dominant part in determining the animal's behaviour.

It is perhaps not without significance in this connexion that the efferent fibres from the hippocampal formation, after passing out of the cerebral hemisphere, terminate in the hypothalamus, that part of the brain which controls the visceral system (sympathetic and para-sympathetic) and thereby regulates the activity of the viscera It is, in fact, that part of the brain which is intimately related to the functions of the appetites Nor is it surprising that the particular part of the hypothalamus in which the hippocampal fibres terminate should be linked up with the thalamus, so as to provide a neural circuit in which the total affective qualities of all the senses are brought into relationship in such a way that they can influence through the striatum the motor responses of the body

The researches of Prof. Le Gros Clark have established the fact that the thalamus contains three kinds of cell groups (Fig. 2). Those forming the ultimate termini of certain of the sensory pathways, which according to Sir Henry Head form the essential organ of the thalamus, are the instrument whereby we become aware of sensory experience and appreciate its affective qualities. Secondly, there is a group of cells (ventral nucleus) which receives the great sensory paths coming up from the other parts of the brain and the spinal cord, and transmits the impulses either to the corpus striatum or in mammals to the neopallium In the third place, there is a group of nuclei in the thalamus which become well developed only in the higher mammals They do not receive afferent impulses directly, but only from the intermediation of the ventral nucleus The highest type of thalamic cells, known as the lateral nucleus (Fig 3), establishes connexions with the parietal area of the neopallium, which intervenes between the sensory cortical areas for touch, vision and hearing (*P*, Fig. 1), and presumably confers upon this area the ability to provide sensory experience with spatial and discriminative qualities All three categories of thalamic elements are intimately joined together by numerous fibre tracts so as to form a closely integrated functional whole the proper working of which is essential for cortical functions

INTEGRATION OF THE DISPOSITIONS OF THE MIND

The common practice of psychologists of segregating the three dispositions of the mind, cognitive, affective and conative, and attempting to study them as isolated units, is devoid of justification. All three are indissolubly united in the working of the mind. To give them cohesion it is necessary to assume the existence of a circulation of nervous impulses from the thalamus to the cortex and to the widespread and complex mechanisms concerned with muscular activities

In the growth of a concept conation plays a fundamental part. Man learns from experimentation By the exercise of his manual dexterity he acquires knowledge of the properties of things, the nature of forces, and the means for interpreting (and in some measure understanding) the world in which he lives. The surprisingly large part of the cerebral cortex that is concerned with the regulation of muscular functions and the multitude of its fibre-connexions with the cerebellum affords an impressive testimony of the vast significance of action in mind-making and emphasises what Prof T. H Pear has well called "the intellectual respectability of muscular skill" It is a truism that we learn by doing In man, thought is a prerequisite for action, and action a corrective of thought The biological justification for the evolution of the high degree of visual discrimination, whereby man knows the world and the society in which he lives, is the motor efficiency it makes possible

The most significant factor in the evolution of the mind was effected when the direction of movements was transferred from the midbrain to the neopallium (see NATURE, 125, p 820, 1930) and from being an unconscious automatism became a consciously directed process For the neopallium not only established a direct control over the motor nuclei of the whole central nervous system, but it also became linked up with all the complicated machinery in other parts of the brain which are concerned with muscular activities

This concentration of control in the neopallium implies a circulation of nervous impulses throughout the brain to effect cohesion between the living instruments of the conative dispositions with those of the affective (thalamus) and cognitive (neopallium) dispositions of the mind A circulation such as Mr Campion postulates is essential to the working of the mind. This circulation in turn involves the hypothalamus, which presumably confers the emotional tone that plays a part in all mental and muscular activity, in particular in artistic expression and the self-knowledge which is one of the most distinctive qualities of man and his thinking

Anthropological investigations, the results of which I have summarised in chaps v and vi of my "Human History" (1930), suggest that in primitive man there is an innate goodness and truthfulness, the awareness of which we call conscience Those qualities of the mind are responsible for character and personality. The terrible experiments which the incidence of diseases such as sleepy sickness (encephalitis lethargica) provides, has shown that these amiable qualities can be destroyed by minute injuries of certain parts of the brain in or in the neighbourhood of the hypothalamus We must suppose that these parts of the brain are responsible for the maintenance of the innate goodness of human nature, the goodwill of normal man, seeing that their destruction causes so profound an alteration of character Mr Campion's hypothesis of a widespread circulation of nervous impulses provides an explanation of how these various dispositions of the mind and character may be integrated into the living human personality

Before I close this discourse, I must express my gratitude to Mr George Campion for his stimulating suggestions and to Prof J S B Stopford, of Manchester, for help in giving them neurological expression

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have also been studied, and in this connexion special attention has been paid to skin diseases among typical Japanese manual workers such as stevedores, octopus fishers, plasterers, carpenters and blacksmiths Every effort is made by the Institute to maintain close contacts with industry, and its *Journal* is now to be issued bi-monthly instead of quarterly, so that the results of its researches may be available as soon as possible Recently also the Japanese Association of Industrial Hygiene—an organisation which is closely connected with the Institute—has considerably increased its activities

The Rockefeller Foundation

THE Rockefeller Foundation's report for 1932 is a tale of activities which, in extent, variety and momentum, are probably unmatched by those of any other agency for world betterment Of the aggregate disbursements during the year, amounting to nearly 14 million dollars, about one fifth was for public health work carried on in almost every country of the globe The report of the director of the international health division covers some two hundred pages and includes a retrospect of the past ten years This is followed by reports of the directors for the medical sciences, natural sciences, social sciences and humanities, and in each case the recital of events of the year is elucidated by reference to previous years' achievements The chapter on the social sciences is of special interest at the present time, showing, as it does, that the framers of President Roosevelt's administration's schemes for national recovery, however handicapped by lack of precedents, were at any rate in a position to draw upon the results of elaborate academic research, to the financing of which the Foundation has for some years made very substantial grants In addition to grants to various institutions for current expenses, including in 1932 grants amounting to 450 000 dollars to the Social Science Research Council in New York City, the Foundation has recently promoted research in specific fields recognised as of specially vital importance, namely, economic planning and control, international relations, and community organisation In 1932, substantial grants were made for research in such subjects as industrial hazards, history of prices, unemployment, employment exchanges, the gold standard, cyclical fluctuations and employment stabilisation

Progress of Agricultural Research in Great Britain

THE collected reports on the work done during the year 1931–32 at agricultural research institutes in the United Kingdom which receive State grants has just been published The volume contains in addition reports on special agricultural investigations for which funds have been allotted Among these the following may be cited investigations on improved grassland management at the Welsh Plant Breeding Station, Aberystwyth, and the University of Bristol, seed potato production at the University College of North Wales, Bangor, land reclamation with *Spartina townsendii* (rice grass) by the Essex County Council, grey squirrel problems at the Department of Zoology, University of Oxford, and the efficacy of chlorates as weed killers at the North of Scotland College of Agriculture A list of papers published by each research institute or centre and the names and addresses of the directors or persons in charge of the investigations are supplied, so that further information on special points can be obtained if desired. The report can be obtained from H M Stationery Office or through any bookseller, price 6s net

THE Royal Agricultural Society, 16, Bedford Square, W C 1, has published the eighth of its annual summaries of the research work carried out in the leading branches of agriculture In previous years the publication has been issued in book form, free on application to members of the Society and available at a nominal charge to the general public In the present year, and for the future, "The Farmer's Guide to Agricultural Research" will form part of the Society's *Journal* and will, therefore, automatically be received by every member A limited number of copies however, are still being bound separately for distribution to the Press and to agricultural education and research centres The survey of scientific work which it provides is not limited to research conducted in the British Isles, but also includes references to results obtained in any part of the world which may have a bearing upon the problems of British agriculture The character of the volume is similar to that of the previous year (1931), except that the section on farm crops which was then omitted has been reintroduced The other sections, namely dairy farming, diseases of animals, farm economics, the breeding of livestock, farm implements and machinery, pests and parasites, and soils and manures remain as before A few copies of previous issues for the years 1925–1931 are stated to be still available

A Natural History Society in Northern England

WHILE interest in museums appears to be growing, many societies devoted to natural history find it difficult to retain the membership of former years. The Northumberland, Durham and Newcastle-upon-Tyne Society is fortunate in having raised its membership, by a small addition, to 613, but even so the cost of running the Hancock Museum is mainly responsible for a raiding of the Maintenance Appeal Fund to the extent of £245, so that the Fund is on the verge of extinction The Museum does good work, and under the guidance of T Russell Goddard and many helpers, is alive to the need for interesting the public by wild-flower exhibits, seasonal exhibitions of *Lepidoptera*, an observation hive, lectures and the like Unless further support is forthcoming, it would appear from the financial statement that the activities of the Museum run the danger of curtailment

First Aid in the Laboratory

WE have received a copy of a pamphlet entitled "Safeguards in the Laboratory", together with a notice suitable for exhibition in the laboratory, both of which are obtainable, price 6d post free, from

Canon Kirkland, The King's School, Ely The pamphlet contains a number of very useful hints for first aid in the laboratory, which have been compiled by the Science Masters' Association and the Association of Women Science Teachers, and it should be very useful in the school laboratory. It should be noted, however, that the administration of an emetic, particularly salt solution, as stated, is not advisable in the case of mercuric chloride without first giving immediately white of egg. the section on poisons is not sufficiently detailed to be of much real value. The statement that "the naphtha used for storing sodium should be of the native rock-oil variety" is rather obscure

Ross Institute and Hospital for Tropical Diseases

Reports of the annual general and extraordinary general meetings of the Ross Institute and Hospital for Tropical Diseases, held on November 27, have now been released for circulation. At the eighth ordinary general meeting, the chairman, Sir Charles McLeod, surveyed the work of the Institute during the year, and the Council and Executive Committee were re-elected. At the extraordinary meeting, it was resolved to approve and confirm two agreements made between the Ross Institute, of the one part, and the London School of Hygiene and Tropical Medicine, and the Seamens' Hospital Society, respectively, of the other part, whereby the Ross Institute is amalgamated with the London School of Hygiene and Tropical Medicine, and the Ross Hospital is incorporated in the Seamens' Hospital Society by the establishment of a "Ross Ward" in their Hospital for Tropical Diseases The Court and Senate of the University of London have expressed their satisfaction respecting the arrangement with the School of Hygiene The Ross Institute thus comes to an end, but the name of Ross will still be perpetuated in the new amalgamations

Gift to British Association

The Committee formed in Leicester in connexion with the meeting of the British Association there in 1933 had a surplus of £1,000 in hand after meeting all the local expenses of the meeting This sum has been handed over to the Association, to form the "Leicester and Leicestershire Fund, 1933" for the assistance of a student or students working for the advancement of science. The fund will be administered by the Council of the Association, and, when possible, assistance will be given preferably to a Leicester or Leicestershire student or worker. The Council, in accepting the gift, has expressed its appreciation of the action of the Committee "in thus confirming, in a manner without precedent in the history of the Association, their interest in the advancement of science".

Continuation of Empire Marketing Board Research Work

Mr. G. Gledhill, in the House of Commons on February 6, asked Mr. J. H. Thomas, Secretary of State for Dominion Affairs, if any arrangements have been made for carrying on the research work previously undertaken by the Empire Marketing Board. In a written answer, Mr. Thomas stated that such arrangements are being made. It is estimated that the cost of such research work in the financial year 1934–35 will reach £200,000, of which some £85,000 will be borne by other Governments of the Empire or by the institutions or industries concerned.

Announcements

Prof P M S. Blackett will give a course of three lectures on "Cosmic Radiation" at Birkbeck College, Bream's Buildings, E C 4, on Tuesdays at 6 p.m. commencing on February 20 Admission to the lectures will be free without ticket

The following appointments in the Colonial Agricultural Service have recently been made · C. A North-Coombes, to be agronomist, Department of Agriculture, Mauritius, C J. Lewin, chief agriculturist, to be director of agriculture, Northern Rhodesia, Capt J P. A Morris, deputy director of animal health, to be director of animal health, Northern Rhodesia

At the annual general meeting of the Royal Astronomical Society, held on February 9, the following officers were elected · *President*, Prof F J M. Stratton, *Vice-Presidents*, Sir Arthur S. Eddington, Mr John Evershed, Dr H. Spencer Jones and Dr. W J. S Lockyer; *Treasurer*, Mr. J. H. Reynolds; *Secretaries*, Mr W M. H. Greaves and Dr W. M. Smart, *Foreign Secretary*, Prof Alfred Fowler, *New Members of Council*, Prof. H. Dingle, Sir Frank W Dyson, Prof. H. F. Newall, Mr W H. Steavenson

In Nature of December 23, 1933, p. 963, under the title "Study of Canadian Coals", a note appeared referring to a report by R E Gilmore and R A Strong in the *Canadian Mining and Metallurgical Bulletin* (p 317, 1933), published by the Canadian Institute of Mining and Metallurgy. The journal was incorrectly quoted as the *Journal of Canadian Mining and Metallurgy*.

Applications are invited for the following appointments, on or before the dates mentioned:—A lecturer in mathematics at Darlington Training College—The Principal (Feb. 21) A museum assistant (male) at the Leicester Museum and Art Gallery —The Director (Feb 28). Staff tutors in psychology, political science, etc, at the University of London—The Joint Hon. Secretaries (Tutorial Classes), University of London, South Kensington, S.W.7 (March 1) A Wakefield lecturer in aeronautics at University College, Hull—The Registrar (March 7) A probationary assistant engineer in the Post Office Engineering Department—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (March 8) A Kennedy professor of engineering at University College, London—The Academic Registrar, University of London, S.W.7 (April 11).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Occurrence of Antirachitic Vitamin in Green Plants

As is well known, antirachitic substances arise through irradiation with ultra violet light It might be presumed, therefore that green plants, which are constantly exposed to the light of the sun would become rich sources of the antirachitic vitamin However, green plants or parts thereof, have hitherto been found to be poor in the above mentioned vitamin This may, perhaps, be ascribed to the fact that the plant material has been prepared in an unsuitable manner prior to examination It may also be however that the irradiation with sunlight has not been so intense as would have been supposed As the summer of 1933 in southern Norway was unusually rich in sunny days (sunny days recorded in Oslo May 25 June 28, July 30 and August 30) we considered it of interest to examine whether green plants this summer would show a larger vitamin D content than is usually the case

For this investigation was used meadow hay, consisting of Gramineæ and some clover, which was rapidly dried by a special quick-drying process (at 68 C for 2 hours—a process which it is now intended to use on a larger scale) The hay was afterwards pulverised The hay powder had a fresh, green colour, and yielded by extraction with ether in a Soxhlet apparatus 4 per cent of a deep green ointment like extract Daily doses of four milligrams of this extract brought about a satisfactory cure of rickets (method Poulsson and Løvenskiold[1]) The ether extract had, in other words, the same antirachitic effect as a high quality cod liver oil, containing about 250 Oslo units of vitamin D per gram This corresponds to 0 25 unit vitamin D per gram of hay powder

Some time ago, Kon and Booth[2] stated that vitamin D in butter showed a marked difference from the vitamin D found in cod liver oil and that obtained by ultra violet irradiation of ergosterol, whereas 80 per cent of the first was lost by the usual saponification, this is not the case with vitamin D from the other two sources We considered it of interest to examine whether this also applied to vitamin D in the above mentioned ether extract of green plants We brought about saponification by means of alcoholic potash lye 8 gm ether extract yielded 0 508 gm ether soluble unsaponifiable matter, that is 6 25 per cent This was diluted with inactive arachis oil until a quantity was obtained equal to that of the ether extract from which we started, namely, 8 gm Of the solution thus obtained, it was necessary to use 20 milligrams in order to obtain the same antirachitic effect as was found in the ether extract before saponification Vitamin D in green plants shows, accordingly, the same characteristics as Kon and Booth[2 3] have described for vitamin D in butter

We found it of interest, at the same time, to record the tintometric reading of the above mentioned solution of the unsaponifiable matter, in arachis oil This was found to be 10 blue units (which corresponds to a high quality cod liver oil) However, the tintometric reading, thus recorded, is probably not due to vitamin A, but to carotene, the precursor of vitamin A as the chlorophyll was removed by the saponification and the unsaponifiable matter showed a very pronounced yellow red colour 1,200 yellow and 20 red units were recorded as self colour on Lovibond's tintometer

OTTAR RYGH

State Vitamin Institute
Skøyen Oslo
Jan 22

[1] Poulsson and Løvenskiold *Biochem J* 22, No 1 1928

[2] Kon S K and Booth R G *Biochem J*, 27 1189, 1302, 1933

[3] Zucker and Barnett *Proc Soc Exp Biol Med* 20 375 1922–23

Assay of Vitamin A

IN carrying out a series of assays by the curative method, of the vitamin A content of various samples of fish oils and dried milk it was found that in a large proportion of cases the weight curve did not give a reliable indication of the state of depletion of the vitamin A stores of the animal and that increase in weight after administration of a supplement could not always be ascribed to its vitamin A content

The experimental data obtained in these assays appeared to conflict with current ideas regarding the special influence of vitamin A on growth An investigation was therefore undertaken to ascertain (1) whether growth does in fact cease in vitamin A deficiency, and (2) the real significance of the loss in weight which is generally described as cessation of growth'

The evidence which has been obtained shows that when vitamin A is the only known factor absent from the diet, there is no cessation of growth, interpreting growth as increase in size This has been determined by measurements of length of the body in the live animal and by comparison of the lengths of the bones measured post mortem with Donaldson s values for the standard rat It would appear that vitamin A has no greater claim to be considered essential for growth *per se* than any other of the many factors which are responsible for increase in weight

The characteristic loss in weight which has been termed cessation of growth appears to be due entirely to pathological conditions arising from the vitamin A deficiency Even in animals killed at a stage when they are still increasing in weight, these conditions may be found on macroscopic examination

The diversity of the pathological symptoms which may arise during the preliminary depletion' period makes it impossible to secure uniformity in the experimental animals at the beginning of the test period This constitutes a source of error which makes the curative method of vitamin A assay of doubtful value It seems probable that the various discrepancies so frequently reported in such assays may find their explanation in the above observations

The results of this investigation, which were presented at a meeting of research workers at Aberdeen on December 18 last, will be published in detail at an early date

J B ORR
M B RICHARDS

Rowett Research Institute,
Bucksburn, Aberdeen
Jan 23

Designation of Heavy Hydrogen

THE frank acknowledgement of Prof Urey and his colleagues in NATURE of February 3 p 173 that the nomenclature of heavy hydrogen should not be decided by the wishes of the discoverers but by the convenience of physicists and chemists in general encourages me to say something in reply to their arguments

To physicists the most important point is perhaps the name to be given to the nucleus More than one physicist who was at Chicago last summer found it difficult to distinguish the spoken words neutron and deuton or deuteron The difficulty may be greater in England than in America all good Americans will realise that in England it always rains and everyone has a cold but in this country at least the danger of confusion seems to me to be serious and it is entirely avoided by using diplon

The names to be employed in chemistry will not be nearly so unpleasant as Prof Urey and his colleagues suggest They say that we should call $NH^1H^2_2$ di diplogen mono hydrogen nitride they would presumably say di deuterium mono protium nitride But the chemist would call it di diplo ammonia just as he calls $C_6H_4Cl_2$ dichlorobenzene and not di chlorine tetrahydrogen cyclohexacarbide Didiplo is no more cacophonous than di deuter didymium was accepted for many years as a satisfactory chemical name Moreover the compounds of H^2 will not always contain two atoms of it in the molecule

The objection that diplogen means making double is not really valid it means making diplon just as oxygen does not mean making sharp but making acids Diplon is the double thing just as proton is the first thing and is used in no other sense than as meaning the H^2 nucleus Deuterium or deutium means the second substance and deuteron or deuton the second particle and it may be argued that the second particle after the proton is the neutron whereas there is no doubt what particle is the double of the proton

The adoption of a new name to distinguish pure H^1 from the isotopic mixture does not seem likely to be widespread but if one is needed the obvious correlative to diplogen is haplogen as Prof Urey suggests and this seems to be a harmless word

Whatever decision may be reached on this question we can at least all agree to use the symbol D for H^2

Lincoln College
Oxford
Feb 4

N V SIDGWICK

Nuclear Spins and Magnetic Moments

A COMPARISON of the two lines of spectroscopic evidence bearing on the properties of the atomic nucleus raises some interesting questions and suggests new directions of research The magnetic moment of the nucleus can only be evaluated from hyperfine structure observations and then only in favourable circumstances The spin quantum number I can sometimes be obtained by both methods by the hyperfine structure method if the magnetic moment and its interaction with the optical electrons is sufficiently large and by the band spectrum method if the atom is one which forms an elementary diatomic molecule provided also that this gives rise to a band spectrum of which the rotation structure can be analysed Although each method is thus restricted in the scope of its application there are a number of cases in which both are applicable for example Li^7 F^{19} and Na^{23} for each of which the two values obtained for I are in agreement On the other hand, P^{31} Cl^{35} and K^{39} are amenable only to the band spectrum method the magnetic moment being presumably too small to give observable hyperfine structure whereas for many other nuclei (for example $Cu^{63, 65}$ $Cd^{111, 113}$ Cs^{133} $Hg^{199, 201}$ etc) the latter method only is applicable since no diatomic molecules giving rise to band spectra are known

The case of nuclei of even mass number is of particular interest No hyperfine structure has been detected for any of these although N^{14} shows some slight indications and such band spectrum observations as are available all give zero values for I with the exception of H^2 and N^{14} for which $I = 1$ (I is half integral or zero in every other known case) It would therefore be natural to assume as has generally been done that all nuclei of even mass number have $I = 0$ except H^2 N^{14} and possibly also Li^6 and B^{10} these four being the only nuclei of even mass number but odd atomic number

Such an assumption would however be quite unjustified on the basis of the present experimental evidence A zero value for I can only be established by band spectrum methods since the absence of hyperfine structure might alternatively be due to a small magnetic moment It is therefore unfortunate that the number of nuclei of even mass number for which diatomic band spectra are known is very small There are in fact only six four of which He^4 C^{12} O^{16} and S^{32} have mass numbers of the type $4n$ where n is integral and zero spins The other two H^2 and N^{14} have been referred to above They have I 1 but may very well be anomalous There are no others having mass numbers $4n + 2$ for which the band spectrum method is practicable at present The most promising appears to be Li^6 the difficulty here being the weakness of the Li^6_2 bands in comparison with those of Li^7_2 and Li^6Li^7 among which they lie The highest possible dispersion applied in a carefully selected region might offer some prospect of success

A survey of the remaining elements of this type shows that in every case one or more of the following obstacles bars further progress

(1) The isotope in question is too rare (for example O^{18})

(2) There are too many isotopes (for example $Te^{126, 130}$) giving rise to extreme complexity of band structure

(3) No suitable bands are known (for example Zn^{66} Se^{78})

(4) No bands at all are known (for example B^{10} Ne^{22} Ni^{58} Zr^{90} Ba^{138})

(1) and (2) would seem to be insuperable unless the technique of isotope separation can be greatly improved As to (3) and (4) the great variety of methods of excitation now available and the wide spectral range now open to photographic investigation give ground for hope that some of these band spectra may yet be discovered Whether or not an exhaustive search for them would be worth undertaking it is at least very desirable that spectroscopists working with such elements and their compounds should be on the look out for new band systems and should endeavour to ascertain the origin of any which may be found

Armstrong College
Newcastle on Tyne
Jan 12

W E CURTIS

X-ray Spectra of the *L*-series of Silicon and Silica

IN a preceding letter[1] we have shown that the *K* and the *L* spectra from aluminium in the metallic state are definitely different from those found with the non-conducting compound Al_2O_3. Analogous phenomena were found by Siegbahn and Karlsson also in the *K*-series of magnesium with the pure element and magnesium oxide (Mg O) (in publication elsewhere). The metals in these cases give broad bands with a sharp edge towards the shorter wave-lengths, which may be explained as transitions from the levels of the conduction electrons. The widths of the bands correspond fairly well with those calculated from the theory.

As it was of interest to see how the next element, silicon, which is a semi-conductor, behaves in this respect, we have taken spectrograms of the element and the oxide SiO_2. As is seen from Fig. 1, here also a broad band with a sharp limit towards the shorter wave-lengths is found for the element. In the band two maxima are visible, which are well pronounced and measurable in the photometric registrations. The wave-length of the edge is 125.5 ± 0.5 A., the maxima are at 134.3 ± 0.5 and 138.2 ± 0.5 A. The non-conducting compound SiO_2 gives a spectrogram of quite another character, with two strong lines at 130.7 A. and 139.5 A. (and a broader fainter line at 162 A.) as seen in the figure. This corresponds with the spectra of aluminium and the oxide Al_2O_3, where the oxide shows two well-marked maxima instead of the band at the pure metal.

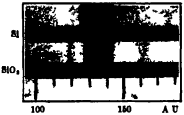

FIG. 1. *L* Series of Si and SiO_2.

MANNE SIEGBAHN
TORSTEN MAGNUSSON

Physics Laboratory,
Uppsala University.
Dec. 22.

[1] NATURE 132, 896, Dec. 9, 1933.

Speed of 'Uniform Movement' of Flame in Mixtures of Carbon Monoxide and Oxygen

IN the year 1931[1] Prof. W. A. Bone and Mr. R. P. Fraser published figures for the speed of the 'uniform movement' of flame in moist (stated to be saturated at 12°–13°) mixtures of carbon monoxide and oxygen. Their values are represented by the crosses in the accompanying diagram (Fig. 1). In a paper published in 1932[2] we challenged both the absolute and the relative correctness of those values. Our results, for mixtures saturated at 13.1°, are indicated by circles in the diagram. Prof. Bone and Mr. J. Bell have repeated the experiments[3] and, whilst unable to confirm the earlier determinations, have obtained some (for mixtures saturated at 15°) that correspond with ours, within the limits of reasonable experimental error, as is shown by their curve reproduced in the diagram.

There remains, however, an outstanding difference. Prof. Bone and his colleagues consider that the maximum speed of 'uniform movement' of flame in moist mixtures of carbon monoxide and oxygen is obtained with a mixture of the composition $3CO + O_2$, whereas our results show that it is obtained with the mixture $2CO + O_2$. We do not offer any explanation for this difference, but suggest that a third party, sufficiently interested in the problem, should reinvestigate it.

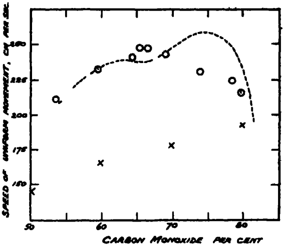

FIG. 1.

W. PAYMAN.
R. V. WHEELER.

The University,
Sheffield.

[1] *Proc. Roy. Soc.*, p. 542; 1931.
[2] *J. Chem. Soc.*, p. 1835; 1932.
[3] *Proc. Roy. Soc.*, 142A, 1; 1933.

SEEING that on p. 1836 of their paper (*loc. cit.*) Dr. Payman and Prof. Wheeler rightly stressed the fact that "with moist carbonic oxide the speed of flame varies considerably with the concentration of water vapour and is therefore subject to alteration from day to day if the temperature of saturation alters", it is curious to find them now citing an alleged 'correspondence' between some of two sets of flame speed measurements for moist $CO - O_2$ media saturated at 13.1° and 15.0° (water vapour = 11.3 and 12.75 mm.) respectively, as confirming the former. For when the difference between the two saturation temperatures is allowed for, the seeming 'correspondence' vanishes.

In repeating the earlier Bone and Fraser determinations—which, however, were for media containing 10.9 mm. only of water vapour—Mr. Bell and I discovered, what had not been recognised before, the importance not only of accurately controlling the hygroscopic condition of the moist $CO - O_2$ media, but also of ensuring a sufficiently large difference (at least 10°) between their saturation temperature and the temperature of the walls of the tube in which they are inflamed; and having taken special precautions to ensure this most necessary condition, we consider our results more reliable than any previous ones.

Seeing that they are largely influenced by environmental factors, the *absolute* values of such initial flame speeds in moist $CO - O_2$ media are of no fundamental import, the real question being where, under given conditions, the maximum speed-point lies on the speed-composition curve. In view of the considerable CO_2-dissociation in CO-oxygen flames, the maximum speed is to be expected with an excess of carbonic oxide. Anyone studying our recent results will (I think) agree with our conclusion that, *provided all due precautions are taken to ensure accuracy in the measurements*, "with moist media, saturated at 15° [it] is attained at the $3CO + O_2$ composition".

WILLIAM A. BONE.

Imperial College,
London.
Feb. 1.

Chladni Plates at High Frequencies

IN order to make a high-frequency oscillator for brass plates, I wound a suitable inductance around a nickel rod twelve inches long and one eighth of an inch in diameter. The inductance was excited at 15,000 vibrations per second from an audio vacuum tube circuit connected through a power amplifier. The nickel rod was in a vertical position and the square Chladni plates were balanced upon it. The figures shown in the photographic reproductions (Fig. 1) were formed in this way.

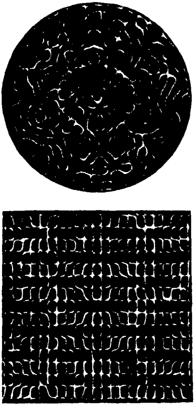

FIG. 1.

When a circular plate was balanced on the rod, only circular nodal lines were formed. I therefore clamped the circular plate at the centre and pressed the oscillating nickel rod against the under side of the plate near the edge.

Calculation shows that the plates oscillate at a submultiple of the oscillation in the rod. They cannot take up such a high vibration as 15,000 per second.

R. C. COLWELL.

Department of Physics,
West Virginia University.
Dec. 15.

Influence of Light on Paramagnetic Susceptibility

SELWOOD[1] has recently published the result of his investigation on the influence of the absorption of light on the paramagnetic susceptibility of certain solutions, in which he fails to confirm our observation of the increase of susceptibility under such conditions. He finds, in agreement with Gorter's observation, that there is a gradual diminution of susceptibility of the solution which can be attributed to a rise of its temperature, due to absorption of light. The method used by him is that due to Decker, in which a test piece of glass of nearly the same susceptibility as the paramagnetic solution is suspended from a torsion head between the pole pieces of an electromagnet. The sensitiveness of his apparatus is claimed to be 0.005 per cent.

It appears to us that besides the sensitiveness of the apparatus used in measuring the change in susceptibility, there is another factor involved, namely, the magnitude of the change ΔK produced by absorption of light. If n_2 is the number of ions per c.c. in the excited state and p_1 and p_2 are the magnetic moments of the ion in the ground and excited states respectively, then

$$\Delta K = \frac{2p_1}{3kT} n_2 (p_2 - p_1),$$

and n_2 will be proportional to the amount of light energy absorbed. In the modified U-tube method used by us in our recent experiments, an account of which has been sent to the *Philosophical Magazine* for publication, we used a solution of $CrCl_3$ containing 0.078 gm. of Cr^{+++} per c.c. with $K = 13.42 \times 10^{-6}$, the horizontal portion of the U-tube is a capillary tube of bore 1.8 mm., which was filled partly with the solution, and the meniscus placed between the poles of an electromagnet of field strength of about 40,000 gauss, and the light from a mercury arc was focused on it. About 81 per cent of the light was absorbed in the solution and the change of susceptibility produced was equivalent to an increase of volume susceptibility of air due to an increase in pressure corresponding to a 2.4 cm. column of water, that is, $\Delta K = 7 \times 10^{-11}$ c.g.s. units. The rise of temperature of the solution was about 0.001° C. per sec.

From our experience, it appears that in Selwood's experiment the amount of light energy absorbed by the solution at the boundary of the test piece, where the magnitude of the change ΔK alone is of importance, was too feeble to produce any measurable deflection with apparatus of the sensitiveness of that used. In the course of our investigation, we have employed a similar type of apparatus to that described by Selwood, but we enclosed the paramagnetic solution in the glass test piece and the outer solution was of colourless $CeCl_3$; with this arrangement we obtained negative results.

Selwood's remark about the difficulty of explaining the increase of susceptibility observed in didymium nitrate as due to a temporary breakdown of *l*-coupling is justified We ought to have mentioned specially that our theory applies only to ions of the iron group

The writing of this letter was delayed due to the absence of one of us in Europe

D M. BOSE
P K RAHA

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Dec 11.

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[1] NATURE, 131, 761, May 27, 1933

Modulation of Very Short Radio Waves by Means of Ionised Gas

ION densities of the order of 10^{11} ions/cm ^{3}, such as occur in gases in glow discharges under the usual conditions, are of the correct magnitude to affect very considerably the index of refraction and absorption of these media for ultra-short radio waves It has been found that the intensity of a beam of radiation of wave length 9 5 cm can be easily modulated by causing it to traverse such an ionised gas in which the ion density is caused to vary

A glow discharge tube of dimensions equal to several wave lengths was used to provide the ionised medium It was connected to a direct current supply in series with an audio frequency voltage The D C supply was used to maintain the discharge at the required level and the audio frequency to provide the variations of ion density for modulation purposes This tube was placed in the radio beam between the transmitter and receiver while music or speech modulation were impressed on it The fidelity of the sound thus received was, as closely as could be noted by the ear, a good replica of the output of the audio amplifier which was impressed on the ionic modulator

Modulation was obtained also by causing the beam to be reflected from an approximately flat surface built up of glow discharge tubes in the form of concentric rings However, the degree of modulation was not as great in this case as when the beam was made to traverse the ionised medium It appears that the modulation is due principally to absorption, although reflection, scattering and refraction also play a part

This method of modulation yields more pure amplitude modulation than does direct modulation of the oscillator, since the frequencies of ultra-short wave generators, such as Barkhausen-Kurz tubes and magnetrons, are quite susceptible to variations in the applied voltages

The oscillator used in this work consisted of a small split anode magnetron, the split anode being 4 mm in diameter and 7 mm in length. The receiver was a crystal detector coupled to an audio amplifier Parabolic reflectors were used with both transmitter and receiver.

Further details will be given in other publications

ERNEST G. LINDER

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Jan 4

Radiation and Ionisation produced by High Energy Electrons

ON the basis of Dirac's theory, Heitler and Sauter[1] have calculated the probability that high energy electrons in their passage through matter emit a quantum of energy comparable to their own These results, as they recognise, are in contradiction to the measurements of Anderson[2] and Blackett and Occhialini[3] on the energy losses of high energy particles The rate of ionisation of a gas by an electron as calculated from Dirac's theory agrees closely, however, with the experimental results

These results indicate either that Dirac's equation cannot be applied to high energy particles or that the structure of the nucleus, finite size and finite potential within its boundary, plays a rôle The rate of ionisation is independent of the potential within the nucleus, whereas the probability of radiation for high energy electrons is decreased in the ratio of the value of the potential within the nucleus to the energy of the electron expressed in equivalent units The finite size plays no part until the energy is such that the waves scattered from the different parts of the nucleus can interfere With this correction to the nuclear model, Dirac's theory gives results which are in harmony with the experimental evidence, and thus seems to be applicable to processes which occur outside the limited region of the nucleus These calculations, which were made by the Born method of successive approximations, were carried to a first order

This decrease in the rate of radiation by high energy electrons, compared to that calculated on the assumption of a Coulomb field for the nucleus, is accompanied by a corresponding decrease in the rate of production of pairs, electron and positron

ARTHUR BRAMLEY

Bartol Research Foundation,
Pa
Jan. 8

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[1] NATURE, 132, 892 Dec 9 1933
[2] *Phys Rev*, 44, 406 1933
[3] *Proc Roy Soc*, A, 139, 699, 1933

The Term 'Mesolithic'

FOR many years it was the custom to regard the line of separation of the Palæolithic and Neolithic periods as roughly corresponding to the geological division between the Pleistocene and Holocene , and even Mr Peake's excellent historical summary (NATURE, Jan 20, p 104) does not make it clear why this position was ever abandoned It is unsatisfactory, and a source of confusion, that the term 'Neolithic' should be used in a broad sense by one generation, and in a very narrow one by the next—that in one case it covers several thousand years in many different lands, while in the other it varies enormously in length in different countries, and in England (where the term originated) it is whittled down to a few decades, with some risk of complete disappearance.

Of course, no one questions that the cultures of Tardenois, Maglemose, etc , are very distinct from that of the 'Age of Polished Stone' , but that could easily have been overcome by a division into Early and Late Neolithic, or, for those who are not happy without new names, into 'Mesolithic' and 'Metalithic' periods. We could then have gone on applying 'Neolithic' in a comprehensive sense to submerged forests, the lower strata of Tilbury and other docks, the Blashenwell tufa of Dorset, and other cases in which no precise dating is at present possible.

Is it altogether too late to return to this convenient arrangement? Such a conservative course may not commend itself to those professional archæologists to whom even such a sesquipedalian invention as 'Epipalæolithic' has no terrors; but it would be a comfort to the general reader, and to those who, like myself, occasionally wander over the border between geology and archæology.

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I AM grateful to my friend Mr. Harold Peake for dealing with this question of the term 'Mesolithic' so fully. Unfortunately, I am unable to doubt that this term has now received wide acceptance among archæologists. But this cannot alter the fact that from the point of view of a correct nomenclature it must be wrong to designate as 'mesolithic' specimens which are agreed on all sides to be referable to the latter part of the Stone Age It is as if I were to be asked to acquiesce in calling 'mid-Victorian', circumstances, or objects, relating to the end of that epoch I cannot believe that it is beyond the wit of archæologists to find some term, descriptive of the period and artefacts in question, which will not violate common-sense. Mr. Peake will perhaps allow me to express doubts as to whether I am the only archæologist who objects to the term 'mesolithic' But, even if his dire prophecy is true, I am cheerfully prepared to remain in a minority of one in this matter

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Inheritance of Egg-Colour in the 'Parasitic' Cuckoos

PROF PUNNETT[1] has suggested that Prof Wynne-Edwards' ingenious hypothesis[2] for explaining how the *gentes* of 'parasitic' cuckoos may be kept distinct despite their promiscuous or polyandrous mating habits could be replaced by the assumption that it is the Y-chromosome of the mother which carries the factor assumed to determine the *gens* to which the offspring belong It is not clear that such an alternative theory has any advantages over the original one (though it might have, were the degree of mimicry invariable). It seems slightly less plausible genetically owing to the paucity of known Y-chromosome genes, and has the distinct disadvantage that it involves the offspring all belonging to the same *gens* as the mother, the "mechanism . . provided for stabilising the population by damping the fluctuations caused by the host species" which is inherent in Prof Wynne-Edwards' theory is therefore lacking.

Both Prof Wynne-Edwards and Prof Punnett assume that the different *gens* factors postulated comprise a single series of multiple allelomorphs. The latter stresses this as an essential corollary, and considers as an objection to the hypothesis the fact that in the domestic hen egg-colour is determined by several independent autosomal genes But the assumption of several pairs of sex-linked factors would explain the observations even better than a single multiple series, since it would account for the imperfection of mimicry found in areas where one species of cuckoo 'parasitises' several hosts Further, Prof. Wynne-Edwards mentioned the probability that autosomal modifiers also exist Prof. Punnett has cited one of many cases in which genes presumed to be phylogenetically homologous are situated on different chromosomes in different species. The assumption of a limited number of sex-linked pairs of genes rather than a single series would therefore seem to remove the only genetical objection raised by Prof Punnett.

C LEONARD HUSKINS

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Dec 22.

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[1] NATURE, 132, 892, Dec 9, 1933
[2] NATURE, 132, 823, Nov 25, 1933

Possible Chemical Nature of Tobacco Mosaic Virus

DR J CALDWELL[1] has criticised some of our statements on the possible chemical nature of the virus of tobacco mosaic. We must point out that the essential precipitant used in the Vinson and Petrie method is not basic lead acetate but neutral lead acetate We are also quite aware of the fact that the addition of two volumes of acetone to one of aqueous $M/1$ KH_2PO_4 solution produces a heavy precipitate of white rhombic crystals, but as Vinson and Petrie and ourselves were concerned with an $M/15$ solution of this salt, Caldwell's criticism is irrelevant. If acetone (two volumes) be added to an aqueous $M/15$ solution of KH_2PO_4 or to an eleuate prepared from healthy sap, only a faint white opalescence makes its appearance and a slight precipitate settles after many hours

It is mentioned in our communication that the crystalline fraction of the acetone precipitate is mainly composed of phosphate, but we still maintain that, although infective, it contains no nitrogen. The statement that the *N. glutinosa* method is a quantitative one for determination of virus is misleading, as at best the method can only give a very rough approximation of the relative concentration of the virus in samples of high dilution.

E BARTON-WRIGHT.
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[1] NATURE, 133, 177, Feb 3, 1934

A Tame Platypus

WITH reference to the platypus mentioned in NATURE of September 16, 1933, p 446, Mr. R Eadie, who has attended to the animal, informs me that it is still alive and has been, at the date of writing, in captivity for 282 days.

The references to diet require modification The daily ration is at present 10 ounces of worms, 50 small tadpoles, wood grubs two or three times a week, and 2 eggs—usually duck eggs—every night. The eggs are prepared in the form of a batter and then steamed. When cold the mass is stirred with a fork until it consists of pieces the size of a large pea. Mr. Eadie estimates the quantity of food consumed at fourteen ounces daily. The weight of the platypus at the time of writing is three and a quarter pounds.

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Research Items

Mental Tests of the African. The difficulties and special methods requisite in the study of the African by the employment of intelligence tests are discussed by Dr. R. A. C. Oliver, Carnegie fellow for educational research in Kenya, in *Africa*, vol. 7, pt 1 Dr. Oliver has been engaged in the study of general intelligence, and in a lesser degree of musical talent, in Kenya natives. His general tests were devised to measure the intelligence of natives who had received some schooling, and were non-verbal tests, the problems being presented in pictures and other symbols. The kind of test to be used varies with the feature of African mentality in which we are interested; but we ought to know more about the African's abilities in specific activities and their special strength or weaknesses The type of test will also depend on education and the language situation. Two lessons are suggested by experience first, that it is highly desirable to precede the test with a demonstration and practice; and secondly, that the time allowed should be unlimited or ample An application of a general intelligence test to 124 pupils of a secondary school for European boys and 93 pupils of a secondary school for African boys in Kenya produced two main facts The average mark of the African was 85 per cent of the average mark of the European, secondly, 14 per cent of the Africans gained a mark as high or higher than the average European mark. This leads to a conjecture that, comparing the variability with that of Europeans, a small percentage of Africans might be capable of a university education; a larger percentage might complete the secondary school course; a still larger percentage might undertake a few years in the secondary school and the mass of the African people might take a full primary school course

European Bitterling spawning in American Mussels. The bitterling (*Rhodeus amarus*), a European minnow, was introduced into Sawmill River, New York, in or before 1925, and after surviving for a few years disappeared. The suggestion was made that lack of suitable mussels, within which the eggs might be deposited, determined the disappearance of the bitterling. C. M. Breder, however, has made special observations of bitterlings and American mussels, kept together in an aquarium (*Copeia*, 1933, p. 147). Although actual oviposition was not observed, the courtship behaviour of the fishes agreed with the descriptions in European aquarium journals, and when one of the mussels was opened four days later, seven bitterling embryos were found in the gill folds, embedded as described for European mussels. The first opened mussels belonged to the species *Unio complantus*, but two specimens of another species, *Anodonta cataracta*, contained three and ten embryos respectively. Since in Europe *Rhodeus* is known regularly to use both *Unio pictorum* and *Anodonta cygnea*, it would seem that a considerable variety of mussels is available for the peculiar reproductive habits of the bitterling, and that other causes than the unsuitability of the mussels must be sought to account for the disappearance of the specimens set free in an American stream.

Fossil Insects from the British Rhaetic and Lias. The Trustees of the British Museum issued during 1933 the third of their series of publications on fossil insects The present work is in the form of a small handbook entitled "The Panorpoid Complex in the British Rhaetic and Lias" by Dr. R J Tillyard. The material upon which it is based consists of nearly one hundred specimens, contained in the British Museum, with a further eleven specimens in the Museum of Practical Geology. It includes examples belonging to the orders Neuroptera, Mecoptera, Paratrichoptera, Trichoptera and Diptera These groups, along with the Lepidoptera (not represented among the material) form a related assemblage of orders which constitute what Dr. Tillyard has termed the Panorpoid Complex. They centre around the primitive order Mecoptera, and it is to this group that most of the specimens dealt with in this memoir belong The Mecoptera in the collection include nine species, embracing four genera, of which three of the latter were previously undescribed The Neuroptera comprise two new species, each representing an already known genus, while the only Paratrichopteron forms the type of a new family—the Liassophilidæ The Trichoptera are represented by fourteen specimens, all pertaining to species (mostly new) of the genus *Necrotaulius*. Of the Diptera there are only three examples: these are Tipaloid forms which are referred to the new genus *Liassotipula* and the new species *anglicana* As is usual among British Museum publications, this work is well printed and admirably illustrated It is obtainable through booksellers or from the Museum, price *5s*.

Studies on Cuticle. V B. Wigglesworth has recently recorded observations on the cuticle of the blood-sucking bug, *Rhodnius* (*Quart J. Micr Sci.*, 76, Part II, 1933) The cuticle consists of two primary layers—a very thin epicuticle and a relatively thick endocuticle traversed by fine pore-canals The epicuticle is composed of material (cuticulin) the chemical properties of which are like those of the cutin or suberin of plants The endocuticle is composed of protein and chitin, and is made up of two layers. The nymphal stages of *Rhodnius* ingest from six to twelve times their weight of blood at a single meal and the adults may take three times their own weight. The abdomen is therefore capable of great distension, which is accomplished in the nymph and the adult in a different way. In the former the endocuticle is flexible and free from cuticulin, and in the fasting nymph the overlying epicuticle is thrown into deep folds When the abdomen is distended with blood the endocuticle is stretched and attenuated and the folds of the epicuticle are smoothed out. In the adult the outer part of the endocuticle is permeated with cuticulin, is rigid and can not be stretched. A deep longitudinal fold or pleat in the lateral wall of the abdomen permits distension of this region. The dermal glands and their ducts, the structure of the epidermis, including the cells crowded with spheres of uric acid, the process of moulting and the formation of new cuticle are described. It is suggested that the œnocytes, a new generation of which arises at each moult (except the last) from embryonic cells in the epidermis, synthesise some of the nonchitinous constituents of the cuticle during moulting and of the egg-shells during maturation of the ova.

Research on Lichens A paper by Miss A Lorrain Smith in vol. 18, pt 2, of the *Transactions of the British Mycological Society* reviews recent lichen literature (pp 93–126) The author describes several works on lichens which have appeared during the last two years Perhaps the most monumental of them is Zahlbruchner's "Catalogus Lichenum". Contributions to our knowledge of gonidia, parasymbiosis, lichen structure, soralia, isidia, cephalodia, and apothecial reproduction are reviewed critically. The section on physiology collects some very useful knowledge about lichen acids, and paragraphs on the rate of growth, lichens as pests and gall formations are very interesting Systematy and ecology are treated at considerable length, and a bibliography of nearly three hundred references is of great benefit to all students of lichens

Entomogenous Fungi of Egypt. A short bulletin (No 120) of the Technical and Scientific Service of the Ministry of Agriculture for Egypt deals with some entomogenous fungi in Egypt (by Dr R M Nattrass, pp 1–9, Cairo, 1932) The paper describes various fungi which attack Egyptian insects. Species of the genera *Empusa*, *Aspergillus*, *Beauveria*, *Metarrhizum* and *Mucor* are involved, and some of their cultural characters are given. Inoculation experiments are described, but there seems little likelihood that fungi may be used as a method of control for insect pests. The work is admittedly of a preliminary nature, but warrants extensive investigation for the sake of the mycological problems involved

West Highland Tectonics. At the meeting of the Geological Society on January 10, Prof E. B Bailey presented a valuable paper on the structure of the Loch Leven to Glen Roy district Study of the current-bedded quartzites of Loch Leven has confirmed various deductions previously recorded and has led to certain new conclusions T Vogt, S Buckstaff and O N. Rove are found to be correct in claiming the Eilde Flags as the oldest member of the Eilde Flag–Cuil Bay succession. R. G Carruthers is correct in placing three quartzites and three mica-schists between the Eilde Flags and the Ballachulish limestone The gigantic recumbent folds of the district tend to retain their inverted limbs intact and to lose their normal limbs by drag The Am Bodach quartzite is found to belong to the Eilde, and not to the Glen Coe, quartzite, it occurs in a recumbent fold that has its roots four miles farther east The quartzite of the eastern Stob Coire Easain, above Loch Treig, is also Eilde quartzite and marks another large-scale inversion The strong folding of the Fort William slide in Glen Roy, first recognised during a preliminary traverse by R. G Carruthers, has now been established in detail

The Quinhydrone Electrode. The increasing use of the quinhydrone electrode makes a study of its normal potential of importance, and in this connexion some experiments by Harned and Wright (*J. Amer. Chem. Soc*, December 1933) are of interest. The cell: Pt / Quinhydrone, HCl(0 01*M*) / AgCl / Ag, without liquid junction was used, and details as to the preparation of the materials and the technique, the cell being operated in vacuum (a necessity for the silver electrode), are given. By combining the results with those for the cell H_2(1 atm.)/HCl(*m*)/AgCl/Ag, previously investigated, the electromotive forces of the important cell Pt/Quinhydrone, HCl(*m*)/H_2(1 atm) are calculated, and thence the normal potential of the quinhydrone electrode. Values were found at temperatures from 0° to 40°, although side reactions quickly destroy the equilibrium at temperatures above 30° The values for the normal potential of the quinhydrone electrode are expressed in a quadratic equation as regards dependence on temperature, and it is shown that they agree to 0 2 millivolt with those interpolated from the earlier measurements of Biilmann and his collaborators, who measured the potentials directly against the hydrogen electrode The new results are considered the best available at the present time Some peculiarities in the behaviour of the cells are of interest

Vitamins from Egg Yolk and Fish Oil. Dr. N K Basu, working in Calcutta, reports in communications to the Editor that he has obtained vitamin A by irradiation of a sterol isolated from egg yolk, and also that he has succeeded in isolating crystals of vitamin D from a fish oil The egg-yolk sterol has a melting point of 62°–67° C., on irradiation with ultra-violet light of wave-length 2750-3000 A, a substance reacting strongly with antimony trichloride was obtained Spectroscopic examination of the product showed the maximum absorption to be in the ultra-violet at 3280 A, and the blue colour developed with antimony trichloride showed absorption bands at 5720 A. and 6200 A. Crystalline vitamin D was isolated from the oil of *Notopterus chital*, a fish common in Bengal A concentrate obtained from the oil was distilled at a temperature of 120°–140° C and at a pressure of 1 mm On cooling, this crystallised in the form of needles having a melting point of 117°-120° C and showing maximum absorption at 2650 A the crystals gave no precipitate with digitonin The final confirmation of the identity of these two products with vitamins A and D respectively will, of course, depend on the results of the biological tests, which are not reported. The properties of the crystals obtained from the fish oil agree fairly well with those of calciferol It is more difficult to correlate the production of vitamin A from a sterol with the fact of its formation from carotene in the body.

Radiation from Variable Stars The very delicate operation of measuring the radiation from stars with the aid of specially constructed thermocouples attached to the 100-in. telescope at Mount Wilson has previously been mentioned in NATURE (123, 425). The results of observations by E. Pettit and S. B. Nicholson on variable stars during the period 1921–27 have now been published in the *Astrophysical Journal* (78, 320). Observations were made on twenty-one long-period variables, nine irregular variables, two Cepheids, and on Algol. In the case of the long-period variables, it was found that on the average the real energy maximum occurs about 50 days later than the visual light maximum, though the variations of temperature are approximately in phase with the light curves. The average temperature range is from 1800° K. to 2350° K., and the coolest star observed (χ Cygni) varies from 1630° K. to 2260° K. In the case of the two Cepheid variables η Aquilae and δ Cephei, as well as in Algol, the changes in radiometric magnitudes are in phase with their light curves This result is to be expected, since the maximum of energy for stars of this class is in the visual region of the spectrum.

A Velocity-Modulation Television System

MANY of the investigators who are seeking at the present time to develop a practical system of television make use of the cathode ray oscillograph tube in one form or another, since the electron beam in such a tube provides an easily controlled means of scanning the picture to be transmitted. At the receiving end, the cathode ray tube is employed to build-up the received picture by varying the intensity of the beam in accordance with the light and dark portions of the picture. The ordinary type of cathode ray tube, however, gives only a small range of intensity control without the accompaniment of loss of focus of the spot on the fluorescent screen, and special electrode systems have to be arranged to obtain good intensity modulation in this manner. As an alternative to this method, the intensity of the cathode ray beam may be kept constant but its tranverse velocity may be varied as it moves over the picture, the beam being speeded up over the dark portions of the picture and slowed down over the light portions. The corresponding motion of the cathode ray beam at the receiving end thus gives varying illumination according to the speed of travel of the spot on the fluorescent screen, and with the aid of the phenomenon of persistence of vision, a true impression of the shades and contrasts in the picture received is obtained.

The conception of this velocity modulation principle, or variable-speed cathode ray television, dates back to 1911, when it was described in a British patent by B. Rosing. Since that date the principle appears to have fallen into oblivion until it was revived in Germany by R. Thun in 1929. The first practical realisation of the method was achieved by M. von Ardenne in 1931 and reference was made to this work in NATURE of October 7 last (p. 573).

During the development of cathode ray oscillograph tubes for general scientific and technical purposes, the staff of Messrs. A. C. Cossor Ltd. realised the possibilities of the above system of television, and an account of the development work carried out during the past eighteen months was presented in a paper entitled "A Velocity-Modulation Television System", read before the Wireless Section of the Institution of Electrical Engineers by Messrs. L. H. Bedford and O. S. Puckle on February 7.

Consideration of the basic principles outlined above shows that it is impossible to realise a velocity-modulated picture from a uniformly scanned object; the scanning at the transmitter must also be of the variable-speed or velocity-modulated type, and must therefore be carried out by a cathode ray. It follows that a cathode ray oscillograph must serve as the source of light at the transmitting end, and, with oscillographs of the ordinary low-voltage type, the conditions of scanning-light economy will restrict the picture subject matter to cinematograph film material. This, however, is not considered to be a disadvantage of the method; many of the television systems being developed at the present time make use of a film as an intermediary, and processes are being devised in which the interval between the photography of the subject and the projection of the picture through the transmitter is reduced to the bare minimum.

The transmitting arrangements described by Messrs. Bedford and Puckle comprise the projection of light from the fluorescent screen of the oscillograph through the film picture on to a photoelectric cell. The output of the photo-cell amplifier operates, through a screen grid valve and a thyratron, an electrical time base circuit which supplies the potential difference to one pair of the deflecting plates of the oscillograph. The light from the cathode ray tube is thus swept in a straight line across the picture with a velocity which varies according to its transparency at different points. At the end of each scanning line, the discharge of the thyratron provides a 'fly-back' action to the spot sufficiently rapid to be invisible. Simultaneously with this operation, a second valve and thyratron circuit provides a traversing time-base potential difference to the second pair of deflecting plates of the oscillograph tube. By this means the scanning line is traversed across the picture in successive steps.

From this description it will be realised that an image of the picture being transmitted is built up on the fluorescent screen of the cathode ray oscillograph, and this is found to be a useful feature of the system for monitoring purposes. Furthermore, for the reproduction of the image on the screen of another oscillograph tube at a distant receiving station, it is merely necessary to transmit to the second tube the voltages being applied to the two pairs of deflecting plates of the first tube. If these voltages are sent through two separate channels, the received picture is automatically synchronised with that at the transmitting end.

The authors of the paper referred to above have modified this arrangement to some extent, however, to enable all the intelligence to be sent along a single channel. Using a picture frequency of 25 per second with a detail corresponding to 120 or 160 scanning lines, the transmitted signals require a frequency band of the order of 240 kilocycles per second; and special amplifiers have been developed to give uniform amplification over this range. The size of the picture received depends upon the deflector voltages which may be applied to the oscillograph electrodes, and it is anticipated that future design and manufacture will enable a suitable receiver tube with a 9-inch screen to be produced. Among the advantages of the method described above over that employing intensity-modulation are the increased picture brightness for a given receiving oscillograph and the concentration of detail in the light portions of the picture.

Although Messrs. Bedford and Puckle's experiments have so far been limited to transmission over wire lines, no particular difficulty is anticipated in applying the necessary signals to radio transmission, at least on the ultra-short wave-length of a few metres where such a large frequency band as 240 kc./sec. may be permitted. At the reading of the paper, a cinematograph film was shown illustrating typical pictures received in a laboratory test of the whole system. Among the features brought out in this demonstration was the fact that, when required to obtain a better contrast ratio in the received picture, intensity modulation may be superimposed with advantage upon the velocity-modulation signals, and means of achieving this very satisfactory combination are being investigated.

Astronomy and International Co-operation

IN his presidential address to the Royal Astronomical Society at its annual meeting on February 9, Prof. F. J. M. Stratton sketched the development of schemes of international co-operation in astronomy during the last hundred years. The first such scheme was that of the Berlin Academy for a chart and catalogue of stars down to the 10th magnitude, to be completed by a number of continental astronomers by 1828; it was actually not completed until 1858. Along the same lines were the plan of the *A.G.* zone catalogues drawn up in 1869, and later still the more ambitious photographic "Carte du Ciel" set on foot in Paris in 1887 and not yet completed. The founding of the "Centralstelle" for astronomical telegrams and the various activities of the Astronomische Gesellschaft kept the Germans for many years the chief organisers of joint astronomical schemes, but after the Permanent Commission of the Carte du Ciel had been established with its occasional gatherings of astronomers at Paris, the headquarters for international astronomy of position shifted to France.

In Paris were held conferences on fundamental stars and on co-operation in the work of preparing national ephemerides; there too were established the Bureau de l'Heure and the Bureau des Poids et Mesures. The United States became active in this sphere at the Washington Conference of October 1884, when the meridian passing through the centre of the transit instrument at the Observatory of Greenwich was adopted as a single prime meridian for all nations. From the United States, too, came the impetus which founded the International Solar Union; this body performed for solar and stellar physics the same function as that of the Permanent Commission of the Carte du Ciel for the older astronomy.

The War cut right across the older organisations, and in 1919 the International Astronomical Union was founded in an attempt to start once again the sadly crippled forces of co-operation. The new body set up more than thirty committees to deal not only with the work inherited from the earlier organisations but also with many branches of astronomy, such as double stars, which had remained unprovided for owing to the casual way in which the earlier schemes had come into being. Over the whole field of astronomical research the Union, without in any way interfering with individual liberty, has endeavoured to provide a common meeting ground for the discussion of problems and the preparation of schemes of mutual co-operation. Valuable reports from the various committees have been published, notably on standard wave-lengths, stellar photometry and stellar classification; these have been published in the volumes of transactions freely distributed to observatory libraries.

Grants in aid have been made by the Union for the publication of tables and observations, for printing volumes of the "Carte du Ciel", for the Bureau de l'Heure at Paris and the Bureau of the Variation of Latitude at Mizusawa, for computations in connexion with the recent opposition of Eros. (The Astronomer Royal gave an account of the progress of this work at the same meeting of the Royal Astronomical Society—a valuable illustration of the work of the Union.) In all, grants of more than £14,000 have been made by the Union to its committees. The present financial world crisis has not left the Union unscathed, but it is continuing "alive and responsive to new needs and changing conditions, a powerful support of astronomy in all its branches and a centre of co-operative good will among the astronomers of the whole world".

History and Management of the Hope Farm, Jamaica

TO the British Empire, the problem of milk production in the tropics is of paramount importance. It is a problem which at the present moment faces both the administrators and their agricultural advisors in each one of the British tropical dependencies and in India. The "History of the Hope Farm and Part 1 of the Jamaica Herd Book of Pure Bred Cattle" by H. H. Cousins, is an outstanding contribution to this subject (Pp. vi+308+59+54 plates. Kingston, Jamaica: Government Printing Office, 1933). This Jamaican estate, becoming derelict, passed in 1909 into the hands of the Government and represents a somewhat unusual incident in Government operations by which an officer was called upon to justify, as a commercial concern, the acquisition of land as public property, practically without capital and dependent upon the earnings of the enterprise for its development. The assets of the Farm now show a gain of nearly £16,000, or an annual increase averaging £751 from 1910 until 1931.

What will mostly appeal to livestock men in the tropics is the detail which has been put forward concerning the productivity of cows of many pure breeds and of their crosses. Many of the imported cows were of British breeds and came from Great Britain or North America. From India came the Nellore, Sahiwal and other Zebu cattle. The lifetime history of each cow is clearly set out. Several experiments in inbreeding were attempted, but the only one which appears to have had any measure of success involves the mixture of the Zebu with the Jersey. The excellent photographs, studied in conjunction with the records of the animals concerned, provide useful information.

An interesting point in the organisation of this farm, and one which may be commended to the attention of Colonial administrators, relates to its finances. It was recognised from the start that this enterprise should be operated on a separate account at the Treasury. The approval of the Secretary of State was obtained for this departure from the usual system of departmental finances, whereby expenditure was 'debited' and the revenue 'credited' to the general account without any direct connexion between the two. The method adopted for Hope Farm allows that freedom of decision which is essential for the proper conduct of a farm.

More important still is that where genetic experiments with cattle are concerned, the financial establishment of a farm should be along these lines, in order that there may be continuity in method over that period of years which is demanded by the nature of the investigation. Too often has a change in the policy of the Government resulted in the 'axing' of an inquiry of this nature. Twenty-five years is not too long for such an experiment, upon which it may be a waste of time and money to embark unless there is some guarantee that the work will be carried forward. Mr. Cousins has achieved this and it is greatly to his credit and to his foresight at the time the Farm was established. After serving the Colony for a quarter of a century, he is now retiring from the post of Director of Agriculture. This report represents an important section of his work and he must indeed be a proud man who can leave such a memorial of service behind him.

University and Educational Intelligence

CAMBRIDGE.—Dr. P. E. Vernon, of St. John's College, has been appointed to the Pinsent-Darwin studentship for three years.

J. A. Steers, of St. Catharine's College, has been appointed to represent the University at the International Congress of Geography to be held in Warsaw in August–September of the present year.

At Pembroke College, J. W. F. Rowe, University lecturer in economics, has been elected to a fellowship.

SHEFFIELD.—Mr. Arthur Pool has been appointed lecturer in mental diseases.

The Council has received a gift from Dr. Foggo of old medical books, anatomical plates, surgical instruments, etc., belonging to the late Dr. Rooth, of Dronfield.

DR. H. E. C. WILSON, lecturer in physiology in the University of Glasgow, has, with the approval of the Government of India, been appointed professor of biochemistry and nutrition at the All India Institute of Hygiene and Public Health, Calcutta.

APPRAISEMENT of fitness for admission to secondary schools is a task which each year taxes the ingenuity of local education authorities. The technique evolved in grappling with its difficulties in the West Riding of Yorkshire is set forth in some detail in a report by the Education Officer, on the examination for county minor scholarships of some fourteen thousand children of ages 10–12 years, of whom about one seventh were successful. To the written examination in English and arithmetic there was added this year a group intelligence test taken by all candidates in place of an oral test. This was favourably reported on by Prof. G. H. Thomson and was found helpful in dealing with 'border line' cases. The chief examiner's report includes a careful estimate of the evidence afforded by the answer papers in arithmetic of divergence in mental capacity between boys and girls and an expression of a fear "that too often the girls' natural clinging to painstaking methods is reinforced by their training, instead of being to some extent supplanted by the development of that initiative so necessary—even for women—in every walk of life". The report on the examination in English quotes a number of surprising and psychologically interesting 'howlers'. The following essay on "The Importance of Little Things" affords (with many others) evidence, the examiner believes, of ill-assimilated health talks: "An atom is a small animal. It has no legs or arms but has a mouth and means of indigestion. Without these we cannot live: scientists have proved it".

Science News a Century Ago

Baldwin's Locomotive *E. L. Miller*

On February 18, 1834, Matthias W. Baldwin, the founder of the Baldwin Locomotive Works, Philadelphia, completed his second locomotive, the *E. L. Miller*. His first locomotive, *Old Ironsides*, completed in November 1832 for the Philadelphia, Germantown, and Norristown Railroad, was a four-wheeled engine modelled on the plan of Stephenson's engines. The *E. L. Miller*, built for the Charleston and Hamburg Railroad Co., however, was a six-wheeled engine with two driving wheels 4½ ft. in diameter and four smaller wheels attached to a swivelling or 'bogie' truck similar to that first introduced into the locomotive *Experiment* in 1832 by John B. Jervis. The *E. L. Miller* had two cylinders of 10 in. diameter, 16 in. stroke, and it weighed about 7½ tons. Baldwin, who was born in Elizabeth, New Jersey, on December 10, 1795, began life as a jeweller and silversmith. In 1825 with David Mason he set up as a machinist and soon began the construction of small stationary steam engines. With the advent of the steam railway in England, Franklin Peale, the proprietor of the Philadelphia Museum, commissioned Baldwin to make a miniature locomotive. With imperfect sketches of the engines which had taken part in the famous Rainhill trials of 1829, Baldwin made a small engine which drew two cars around a track in the Museum, and it was the success of this model which led to his receiving the order for the *Old Ironsides*. Baldwin died in 1866, by which time he had built more than 1,000 locomotives.

Prediction of the Tides

In 1833 our knowledge of the tides was very imperfect. Bernouilli and Laplace had attempted to formulate rules for prediction on theoretical grounds but without much practical success, and although several tide-tables were published annually, they differed considerably from one another. Sir John William Lubbock had for nineteen years been collecting tide observations for the Port of London, and on February 20, 1834, in a paper "On the Tides" read before the Royal Society, he included tables for the prediction of the tides at London, far more accurate than any previously available. He also described numerous observations on the influence of the wind, which is of considerable importance in limiting the accuracy with which tides can be predicted. The analysis of Lubbock's great mass of data was mainly due to the Rev. William Whewell, who introduced new mathematical methods into the problem. His results were published in a paper read before the Royal Society on January 9, 1834, "On the empirical Laws of the Tides in the Port of London, with some Reflections on the Theory".

Anniversary Meeting of the Geological Society

The anniversary meeting was held on February 21 at the Society's apartments in Somerset House; Mr. Greenough was continued president, and R. I. Murchison and H. Warburton were elected to succeed Dr. Fitton and Prof. Sedgwick, the retiring vice-presidents. It was announced that the proceeds of the Wollaston donation fund had been awarded to M. Agassiz in testimony of the high opinion entertained of his work on fossil fishes, and to encourage him in the prosecution of his important undertaking. The Society dined at the Crown and Anchor Tavern, and afterwards adjourned to their own apartments to hear the remainder of the president's anniversary address

Ashmolean Society, Oxford

At a meeting of this Society held on February 21, 1834, P Duncan, of New College, exhibited part of the contents of a mummy of a crocodile, recently presented to the museum by Mr Munro, and gave some account of crocodiles from Cuvier and other writers. Dr. Daubeny exhibited Daniell's pyrometer, and made some observations on the influence of light on animal life; and concluded by proposing the following query "Is it reasonable to suppose (with Dr Edwards) that the singular animal called the *Proteus Anguinus*, which occurs in the dark caverns of Carniola, is a reptile whose form has never been developed, bearing the same relation to some unknown species which the tadpole does to the frog?"

Agricultural and Horticultural Museums and Gardens

Agricultural Museum, Edinburgh Prof Law, the scientific teacher of agriculture in the University of Edinburgh, has long been engaged in forming, at his own private expense, an agricultural museum; and we are most happy to learn, from the Scotch newspapers, that government has lent pecuniary aid to so useful an undertaking. Whether any exhibition of the kind instituted at Stirling, and followed by Mr Lawson of Edinburgh, and Dickson of Perth, is to be combined with this museum, we have not learned, but we are most happy to see the government of the country taking an interest in such national objects We hope the time is not far distant when a sum will be advanced to complete the Thames tunnel, and another to establish the Horticultural Society's garden at Chiswick on a permanent footing If this is not done by government, we hope that, when the metropolis and its environs are put under one system of self-government, they will have a metropolitan garden, either at Chiswick, or elsewhere, worthy of the first city in the world, and open to all its citizens (J C Loudon, in the *Gardener's Magazine* of February 1834)

Brunel's Thames Tunnel

In February 1834, a collection of models of buildings and public works was on view in King William Street, West Strand, London, the most important exhibit being a model of the Thames Tunnel from Rotherhithe to Wapping. The model, which was on a scale of ¼ in to a foot, was described by the *Times* as doing great credit to the ability, ingenuity and taste of the artist and as an exceedingly accurate representation in miniature of what the tunnel would be when completed Begun in 1825, the tunnel, for which the elder Brunel was the engineer, had attracted a great deal of attention and on one occasion the Duke of Wellington said: "Of my own knowledge I can speak of the interest excited in foreign nations for the welfare and success of this undertaking, they look upon it as the greatest work of art ever contemplated". As in the case of Trevithick's tunnel of 1808, immense difficulties were encountered during its construction. In May 1827, when a distance of 544 ft. had been excavated, there was an irruption from the river This was overcome, but in January 1828 a more serious irruption occurred, which nearly cost the younger Brunel his life, and as funds were then exhausted, work ceased for the time. Various efforts were made to obtain funds from the Government for the completion of the work and the negotiations which finally proved successful were in progress when the model of 1834 was on exhibition to the public. The tunnel, which was 1,300 ft. long, 20 ft high and 35 ft. wide, was closed to the public in 1866, when it was purchased by the East London Railway Company

Societies and Academies

LONDON

Royal Society, February 8 G. SALT Experimental studies in insect parasitism. (1) Introduction and technique. (2) Superparasitism. Statistical analysis of field data relating to natural parasitism by *Collyria calcitrator*, *Ibalia leucospoides* and *Limnerium validum* shows that the parasites were not distributed at random among their hosts. A female of *Trichogramma evanescens* placed on a group of hosts can be observed to avoid ovipositing in hosts already attacked Females of *Trichogramma* are able, at least for a time, to retain their eggs rather than deposit them in parasitised hosts This restraint leads to the deposition of fewer eggs than the parasites are actually capable of laying Females of *Trichogramma* are able to distinguish between large and small hosts and, when the number of hosts is limited, lay two, three or even four eggs in some of the larger ones The hypothesis that the progeny of parasitoids are distributed at random, without reference to the previous parasitisation of the host, is untenable for the species considered MISS D E SLADDEN Transference of induced food habit from parent to offspring (1) Previous experiments with the stick-insect (*Carausius morosus*) in 1912–15 tended to indicate the inheritance of an induced food-habit With the object of testing this possibility a series of experiments was devised. In the first generation few insects took ivy at all readily, only 10 per cent at the first presentation, 32 per cent at the second, 21 per cent at the third, 12 per cent at the fourth and so on for as many as ten presentations before the whole 125 insects being tested were induced to accept ivy. These insects were then grouped according to the presentation at which ivy was taken and reared to maturity on that food-plant. In the next generation 78 per cent took ivy at the first presentation. Other insects of the second generation were tested for preference. An insect on hatching was given both privet and ivy, being required to show its preference at three successive feeds Some insects took only privet, others only ivy and yet others showed no preference These were regarded as neutral Offspring of privet-fed parents, 44 per cent privet, 35 per cent neutral, 21 per cent ivy. Offspring of ivy-fed parents, 28 per cent privet, 37 per cent neutral, 35 per cent ivy. MISS P. A CLAPHAM: Experimental studies on the transmission of gapeworm (*Syngamus trachea*) by earthworms *Eisenia fœtida*, an earthworm commonly found in contaminated soil, is an important intermediate host of *Syngamus trachea*, the common gapeworm of birds. *Lumbricus terrestris*, another earthworm, may also act as intermediate host, but is much less efficient. The third stage larva of *S. trachea*, which hatches from the egg, is ingested by the earthworm; it migrates to the muscles of the body wall, where a thin hyaline cyst is developed around it. It remains dormant in this position, undergoing no further morphological development, until the earthworm is taken in by a chicken or other suitable host The *Syngamus* larva then hatches, finds it ways to the lungs and trachea, where it settles down and grows to an adult gapeworm *Syngamus merulæ*, the gapeworm of blackbirds, has been transmitted to chickens by means of infected *Eisenia fœtida*.

PARIS

Academy of Sciences, January 3 (*C R*, 198, 1–128) **E LECLAINCHE**: Notice on Charles Porcher **J COSTANTIN** Cultural experiments on the potato in the Pyrenees As in previous experiments in the Alps, the yield increases with altitude At a height of 1,400 metres the number of tubers on each plant is higher A higher altitude diminishes the tendency to disease. **P VIALA** and **P MARSAIS**. *Court-Noué*, a parasitic disease of the vine **J CABANNES** and **J DE RIOLS**: The Raman spectrum of water Diagrams of the Raman spectra of water in the gaseous, liquid and solid states are given, together with the spectra of some salt solutions **E. J. GUMBEL**: The mathematical expectation of the *m*th value **P VINCENSINI** The successive transformations of Ribaucour Families of concurrent cyclic systems **BERTRAND GAMBIER** The theorems of Meusnier and Moutard algebraical surfaces osculating at a surface **GEORGES GIRAUD**: Certain mixed problems relating to linear equations of the elliptic type **F. LEJA** A limit function connected with Lagrange polynomials and with closed ensembles **ARNAUD DENJOY** A function of Minkowski **A. KOSTITZIN** Hereditary elastic phenomena and the principle of the closed cycle **MAX SERRUYS**: The rôle of peroxides in the knocking of petrol motors Correction to an earlier communication, of December 18, 1933 **P DUMANOIS** Concerning combustion in motors Discussion of the possible effects produced by the formation of peroxides in petrol motors. **A. ÉTÉVÉ** A low velocity vane for windmills **PAUL BOURGEOIS** and **J F COX**: The distribution of the inclinations and eccentricities of the orbits of the minor planets. **AL. PROCA**: The quantic mechanics of protons **PIERRE VERNOTTE** The measurement of the thermal conductivity and specific heat of insulators. **V POSEJPAL**. The materialisation of the ether. **A. COTTON**. Remarks on the preceding paper. **MAURICE ROBERT** and **RENÉ OZOUX**: A new amplifying voltmeter **J CAYREL** Remarks on the note by Anastasiadès on the mechanism of rectification in magnesium–copper sulphide rectifiers. The author holds, contrary to the view of Anastasiadès, that the sulphide (CuS) plays the principal part in the rectification and that the effect of the cuprous sulphide is secondary **PAUL JANET**: Remarks on the preceding communication It is pointed out that Anastasiadès and Cayrel are practically in agreement so far as their experimental results are concerned, but differ in their hypotheses regarding the respective actions of cuprous and cupric sulphide in the rectifying effect Further work on the question is necessary **JEAN LECOMTE**. The infra-red absorption spectra of the monohalogen derivatives of the saturated fatty hydrocarbons. There is, on the whole, good agreement between the positions of the maxima measured and those predicted from the Raman effect. **D. SÉFÉRIAN**: A method of producing the spectrum of atomic nitrogen (NI) The arc is formed between two tungsten wires in an atmosphere of nitrogen The lines due to neutral atomic nitrogen are given and compared with the wave-lengths given by Duffendack and Wolfe. **A. GRUMBACH** and **MLLE M RIBAILLIER**: The photoluminescence of potash and soda The fluorescence of these alkalis is due to the presence of traces of an organic compound, probably a formate: it is not due to the water present **RENÉ LUCAS**, **MARCEL SCHWOB** and **ANTOINE GOLDET** The thermal variation of the magnetic double refraction and dispersion of ethyl phenylsuccinate The results, given in both tabular and graphical forms, can be interpreted by the hypothesis of molecular polymorphism **P. JACQUET** The structure of the electrolytic deposits of copper obtained in the presence of certain colloids The deposited copper was examined by metallographic methods. Colloids differ in their effects; gelatine and serum albumen are very active, gum arabic and tragacanth are less active, dextrin and glycocoll are almost inactive **MLLE Y. CAUCHOIS** Focalisation of X-rays by plane crystalline sheets **HORIA HULUBEI** Methods of focusing [of X-rays] in the analysis of crystalline powders **F JOLIOT**: The dematerialisation of pairs of electrons **PARISELLE** and **DELSAL** The polarimetric study of the ferri-tartaric complexes **J COURNOT**, **M CHAUSSAIN** and **H FOURNIER**. The behaviour of some light alloys towards marine corrosion The degree of resistance to corrosion varies considerably with what would at first sight appear to be very slight changes of chemical composition, the presence of an additional 0 3 per cent of manganese reducing the loss of weight by corrosion to one half **LOUIS MÉDARD** and **MLLE THÉRÈSE PETITPAS** Observation of the Raman OH band of nitric acid **MLLE B GRÉDY** The spectra of some acetylenic alcohols **ANDRÉ CHRÉTIEN** and **RAYMOND ROHMER** The hydrates of nickel sulphate

(*To be continued*)

VIENNA

Academy of Sciences, Nov 2 **EMIL DITTLER** and **J. SCHADLER** The meteorite of Prambachkirchen (Upper Austria). This meteorite, which fell on November 5, 1932, weighed 2,125 gm and had a density of 3 583 at 4° C It was composed largely of iron, silica and magnesia, and mineralogically consisted of 5 77 vol per cent of troilite, 4 27 of nickel-iron, 0 18 of ilmenite, 0 97 of merrilite, 16 92 of oligoclase and oligoclase-masktelynite, 44 of olivine with about 25 per cent of fayalite, and 27 86 of bronzite with 24 per cent of hypersthene. **ALEXANDER KÖHLER** and **HANS LEITMEIER**: Results of investigations on natural thermoluminescence in minerals and rocks Of about a thousand specimens examined, 19 mineral species almost always showed characteristic thermoluminescence In some cases, but not all, the thermoluminescence was accompanied by radioactivity **GEORG STETTER** and **JOSEF SCHINTLMEISTER**: Method for investigating corpuscular rays with a double chamber and a double-tube electrometer. **GEORG KOLLER**, **KARL PÖPL** and **ERICH KRAKAUER**: Ramalic acid This acid, which is shown to be identical with protocetraric acid, yields cetraric acid on alcoholysis. **HERMANN TERTSCH** Results of cleavage measurements on anhydrite. **THEODOR PINTNER**: The excretion system of cestodes. **FRANZ GRIENGL**, **FRITZ** and **KARL STEYSKAL**: Conductivity and solubility relationships in the two ternary systems $Na-K-NH_3$ and $Na-Li-NH_3$

between − 40° and − 70° The conductivity of K−Na and Li−Na alloys in dilute solution in ammonia is virtually additive, and gives no indication of the formation of compounds. In the first case, the solubility curve is composed of three branches, corresponding respectively with the solubilities of sodium, the compound Na_2K, and potassium, but in the second, transition from the solubility of lithium to that of sodium is scarcely discernible.

Nov. 9 JULIUS ZELLNER. (1) Chemistry of lichens (3): *Parmelia* (*Hypogymnia*) A practical method for separating lichen acids is given Substances not hitherto observed include ergosterol, a hydrocarbon, solid and liquid fatty acids, amorphous lichen acids, two new indifferent lichen compounds (hypogymnoles), amorphous polysaccharides, erythritol and lichenin (2) With JARA BISKO. Contribution to comparative plant chemistry (25): Chemistry of barks The bark of *Zizyphus* contains ceryl alcohol, fatty acids, amorphous resin acids, a compound of the platanolic acid type, phlobaphens, tannins and invert sugar. The following new compounds have been found in the bark of *Fraxinus*: ceryl alcohol, a sterol, fatty acids, tannins and invert sugars, real bark substances were lacking. LUDWIG LAMMERMAYR Floral results of an inspection of the magnesite strata of Dienten (Salzburg) Of interest is the occurrence of *Calluna vulgaris* and *Erica carnea*, the former predominating where humus is plentiful and the latter where it is scarce RUDOLF WAGNER: Methodics of prefloration investigation

Nov 16 ARTHUR HAAS Energy-balance of the radiation in the universe The displacement of the red in the spectra of the extra-galactic cloud indicates that all light quanta undergo regular diminution of their frequency and energy. It seems possible that such diminution in energy is counterbalanced by the continual new radiation of the cloud JOSEF HOFMANN Varying β-γ-colorations of the $Na_2O . 2SiO_2$ glass, and the causes of the pure violet colours in manganese-free glasses HANS MOTZ and FRANZ PATAT Ortho and para states of hydrogen of mass 2, the temperature course of the heat of rotation of H_2^2 E CHWALLA The general stability problem of thin plates strengthened by edge-angles KARL FRITZSCH. Observations on flower-visiting insects in Styria, 1914

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, February 19

UNIVERSITY COLLEGE, LONDON, at 5 30—Mr K de B Codrington "India, the Village as a Social Unit" *

ROYAL GEOGRAPHICAL SOCIETY, at 8 30—A. R Glen "The Oxford University Expedition to Spitsbergen"

Tuesday, February 20

KING'S COLLEGE, LONDON, at 5 30—Dr H. J Gough "Fatigue of Metals—A Survey of the Present State of Knowledge" (succeeding lectures on February 27 and March 6) *

BIRKBECK COLLEGE, at 6—Prof P M S Blackett "Cosmic Radiation" (succeeding lectures on February 27 and March 6) *

Thursday, February 22

CHEMICAL SOCIETY, at 8—(in the Lecture Theatre of the Royal Institution, Albemarle Street, W 1)—Prof. Hans Fischer "Chlorophyll" (Fourth Pedler Lecture) *

Friday, February 23

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS, at 5.30—(at the Royal Society of Arts, John Street, Adelphi, W C 2)—Capt F G Ramsay "The Laying and Maintaining of Submarine Cables" *

ASSOCIATION OF TECHNICAL INSTITUTIONS, February 23–24 Annual meeting at the Draper's Hall, London, E C 2

February 23, at 10 45—W. Spens Presidential Address

Official Publications Received

GREAT BRITAIN AND IRELAND

Report of the Departmental Committee on Sterilisation (Cmd 4485) Pp 137 (London H M Stationery Office) 2s net

The Journal of the Institute of Metals Vol 52 Edited by G Shaw Scott Pp 255+50 plates (London Institute of Metals) 31s 6d

British Standards Institution No 526 British Standard Definitions of Gross and Net Calorific Value Pp 5 (London British Standards Institution) 1s net

Hastings and St Leonards Natural History Society Report and Balance Sheet for the Session 1932–33, with List of Officers and Members, etc Pp 16 (St Leonards)

War Office Report on the Health of the Army for the Year 1932 Vol 68 Pp iv+155+6 charts (London H M Stationery Office) 2s 6d net

OTHER COUNTRIES

Bulletin of the National Research Council No 90 Physics of the Earth, 6 Seismology Pp viii+223 2 dollars No 91 Industrial Research Laboratories of the United States, including Consulting Research Laboratories Fifth edition Compiled by Clarence J West and Callie Hull Pp 223 2 dollars No 92 Numerical Integrations of Differential Equations Report of Committee on Numerical Integration Pp 108 1 dollar No 93 Systems of Electrical and Magnetic Units Papers presented before the American Section, International Union of Pure and Applied Physics, Chicago, June 24, 1933 Pp vi+112 1 dollar (Washington, D C National Academy of Sciences)

Department of Agriculture Straits Settlements and Federated Malay States Economic Series, No 3 Malayan Agricultural Statistics, 1932. By D H Grist Pp iv+64 50 cents General Series, No 16 List of Experiments at present in Progress at the Government Experimental Plantation, Serdang Pp iii+29 50 cents (Kuala Lumpur)

Report on the Administration of the Meteorological Department of the Government of India in 1932–33 Pp 39 (Delhi Manager of Publications) 12 annas, 1s 3d

Smithsonian Miscellaneous Collections Vol 88 Smithsonian Physical Tables Eighth revised edition Prepared by Frederick E Fowle (Publication 3171) Pp liv+682 (Washington, D C Smithsonian Institution)

Department of Agriculture Tanganyika Territory Pamphlet No 10 The Red Locust By W V Harris Pp 10+1 plate (Dar es Salaam Government Printer) 50 cents

Association of Mine Managers of the Transvaal (Incorporated) Some Aspects of Deep Level Mining on the Witwatersrand Gold Mines, with Special Reference to Rock Bursts. Pp 198+15 plates (Johannesburg)

Smithsonian Miscellaneous Collections Vol 87, No 20 Pliocene Bird Remains from Idaho By Alexander Wetmore (Publication 3228) Pp ii+12 (Washington, D C Smithsonian Institution)

Memoirs of the Peabody Museum of Natural History Vol 3, Part 3 A Revision of the Ceratopsia or Horned Dinosaurs By Prof Richard Swann Lull Pp xii+175+17 plates (New Haven, Conn) 4 dollars

CATALOGUES

Microscopes and Accessories 35th edition Pp 116 (London. W Watson and Sons, Ltd)

Insulin—Boots Pp 46 (Nottingham Boots Pure Drug Co, Ltd)

Rapid Testing by Fluorescence. Pp. 16 (Slough. The British Hanovia Quartz Lamp Co, Ltd)

Vacuum Thermocouples (Vac 34) Pp 2 Electrometer Triode (Trio 33) Pp 2 Pointer Galvanometer (Na 34) Pp 2 (Delft P J Kipp en Zonen)

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Intellectual Freedom

AS years count, little more than a generation has passed since Huxley died Prof A V Hill's Huxley Memorial lecture on "The International Status and Obligations of Science" (see NATURE, Dec 23, pp 952–954), while stressing the world's debt to Huxley for his vindication of intellectual freedom, reminded us, if any reminder were needed, that since the War, in far less than a generation, indeed in a period of a little more than the last ten years, we have seen the making of a new world, the world of the dictator, in which the spirit is as alien to that of Huxley's day as was the spirit of the Middle Ages

In retrospect it is easily possible to attach too great significance to the opposition encountered by the scientific ideas propounded by Huxley and the school of thought of which he stands as the representative The nineteenth century was an age of great expansions By an almost daily experience its horizons were enlarged The extension of commerce and industry made possible by the growth of population and new markets opened up by travel, exploration and settlement, the increase of political power among the people, and the spread of education confirmed society in a dynamic attitude towards the problems of life To this attitude the concepts of an evolutionary philosophy and the scientific ideas of Darwin and Huxley were more nearly akin than the static appeal to authority of those by whom they were opposed It was an age which believed in the possibility of progress, in the possibility of a continuous and progressive amelioration in the conditions of life and above all in the potentialities of man himself Backward, barbarous and uncivilised peoples, all, it was thought, might be raised to the status of the most advanced in course of time, given education and training

To a generation which came to maturity in the latter half of the nineteenth century, freedom of thought was the natural corollary of the complete emancipation of the individual, which had been the prevailing tendency of preceding years, and was, it was then thought, the goal of future progress. The removal of disabilities due to birth, status or religion by movements, such as, for example, Catholic emancipation and the throwing open of the universities, particularly the admission of non-conformists, seemed to be the counterpart of the abrogation of authority and the freeing of inquiry in the sphere of the intellect, which had been initiated by Bacon, himself a product of the spirit of the Reformation, in the application of scientific method and experimental investigation to the problems of natural science, and of which the final stage, apparently, lay open with the acceptance of evolutionary doctrines and the annihilation of the concept of fixed species as god-created entities As in the political world the efforts of conservatism were directed towards tempering progressive measures by a compromise with established institutions which would not bar forward movement, so in matters intellectual, when once the complete verbal inspiration of the Bible was recognised to be no longer tenable, the efforts of the keenest minds among the orthodox e directed towards the reconciliation of science and religion, rather than to an endeavour to mark off a forbidden territory by chains of authority, which, it was seen, advanced thought would either pass by or overleap

This was a world of which Huxley was both a product and a formative influence He taught a public which was ripe to give hearing to his doctrine It is unnecessary to labour the point by further analysis of the complex interweave of social and intellectual movement of that day There are, however, two tendencies, or factors, to which reference may be made for their bearing on present problems These are the international status of science and the relation of science to politics, and questions of policy in connexion with social problems

On the general question of the international standing of science little need be added to the references to the position in the past which were made by Prof Hill in his address Science and learning and, in a lesser degree, art, as he showed, in the past have transcended national boundaries and have been accorded international status. On the other hand, in recent times, the free interchange of ideas which is the end and justification of the claim of science to be regarded as free of all frontiers, has been, in Great Britain at least, e form of expression of the belief in the ultimate unity and solidarity of mankind as a whole, which underlies the intellectual internationalism of the medieval church, and in the Protestant world of later times has inspired humanitarian movements such as the emancipation of the slaves and intervention on behalf of oppressed peoples on various occasions

The question of the relation of science to politics and socio-political problems opens up a field which offers opportunity for wide divergence of opinion, as is shown in the correspondence between Prof Hill and Prof. J B. S. Haldane which has appeared in our columns (see NATURE, Jan 13, pp 65–66) Prof Hill's contention that science holds a privileged position in consequence, and on the condition of, its detached attitude towards matters which are the subject of political or social controversy and partisanship is unquestionably sound in so far as it affects the objects and conditions of pure scientific research The object of the research worker is the attainment of truth, of the teacher of science the inculcation of the methods of attaining that object and the demonstration of the progress which has been made towards it In neither case must there be bias due to extraneous influence or any attempt to sway the judgment of those under instruction, whether it be a class or the wider audience of the general public, a body of opinion of increasing importance in these days of broadcasting

On the other hand, the scientific worker is a citizen, and as such it is his civic duty to bring his special knowledge to bear on the problems which present themselves to him as a member of the State Further, as a specialist he may be called in to minister to the ills of the body politic He alone has the specialised knowledge which can apply the results of research carried out in an academic atmosphere of detachment to the practical problems of life Moreover, as the State in the performance of its function of ensuring for its members the best possible conditions of life, work and even of amusement, substitutes for regulations framed by rule of thumb, legislation which is in accord with the most recent dicta of science, the aid of the man of science is invoked with greater frequency and over a wider field He may even be asked to frame a policy, or he may feel called upon of his own initiative to point out the way of future progress He becomes a propagandist in the better sense. In the earlier days of the Rothamsted Experimental Station, for example, it would on occasion have been difficult to draw the line between agricultural instruction and propaganda

To a great extent the application of scientific methods and scientific ideas to the problems of government and administration has been an outcome of the theory of State intervention, of which the wide extension is the outstanding contribution of the nineteenth century to political thought and practice It is true that on occasion science has found government departments somewhat difficult to persuade that the course of action dictated by scientific considerations was expedient or advisable. Yet on the whole, the fact that State regulation is a necessity which impinges on every side of the life of the community and affects it in multitudinous detail, in the long run has ensured that these regulations should be framed in the light of the results of scientific research Whatever may be the defects of bureaucratic government, it does afford greater opportunity for the rational application of scientific method to domestic problems, unattainable in a pure democracy, failing the Utopian condition of a scientifically educated public and an executive fully and continuously abreast of the development of science and its practical applications.

The War marked the close of an epoch—a period, in which, it has been attempted to show, the political atmosphere fostered freedom of scientific inquiry, the free interchange of scientific ideas and personnel on an international basis, and an increasing application of scientific methods and results to conditions in every department of the citizen's daily life.

From the welter which followed on the conclusion of peace, we are only now beginning to emerge, and that only in so far as the conditions on which recovery will be attempted are becoming defined Impressed by the results achieved by national discipline during the War, perhaps remembering how, at first under Bismarck's guidance and then under the Kaiser, the German States were welded into the most powerful national organisation of modern times, the foremost peoples of the world are placing themselves under the control of the organised State, consolidated on a national basis, of which the political and economic segregation is emphasised at every turn, but more particularly by tariffs, exchanges and trade balances, States in which an all-powerful emotional appeal is afforded by devotion to a political theory as in Russia, the call of race or nationality, as in Germany, or of loyalty to a leader who exercises a dictatorial power as in Italy or the United States of America.

With the merits and demerits of a political system, strictly as such, we have no concern in these columns, except in so far as it may become the subject of scientific sociological investigation. But it is of vital interest to science that what may be the relation of political theory and practice under the organised State, founded on a nationalist basis, to scientific inquiry should be clearly apprehended. The atmosphere of political freedom of Huxley's day, in which scientific inquiry grew to its full stature, has vanished. Is science to go back under a system of State control to swaddling clothes ?

To the social reformer and the scientific worker who hates the waste of life, time and energy under rule of thumb and tradition, the organised State under dictatorial power, whether wielded by a cabinet or an individual, presents many attractions. It abrogates government by the Press, and the otherwise uninstructed vote of the mass. In it the man of science rightly sees no more than an extension of the bureaucratic regime of State control which in the past has been instrumental in applying the progressive concepts of science to social amelioration No doubt future generations will rise up to call General Góring blessed, because he has decreed a reserve for the preservation of the wild animals of northern Europe, yet had his verdict gone the other way, who could now prevail ? And those who applaud the work of archæological exploration and restoration which the Duce has promoted to the glory of the Italian nation may be pardoned if they feel some qualms lest the claims of some period or subject less complimentary to the Italian genius be overlooked. Who or what is to ensure that the organised State in the exercise of its power of control shall not dictate to science what subjects may or may not be matter for inquiry, and the direction that inquiry shall take ? The Dayton trial has not yet sunk into oblivion, and to-day in Germany the whole State organisation and the fabric of society rest on a pseudo-scientific theory of Aryan supremacy, once formulated for political reasons and long ago exploded outside her national boundaries, but internally not to be questioned To conform to that illusion Germany has closed her frontiers , she has evicted some of her greatest scientific investigators, with thousands of the rank and file, content, as it has been put, that her science should lag behind that of the rest of the world, provided that it were German; and finally, in the full spirit of the Hebrew Scriptures, if repudiating them in form, she seeks to evolve a German God, barely refraining from invoking by name Wodan, the God of Battles, who has risen again.

Since the above was written, we have received the circular on the teaching of history in Germany of which a translation appears in this issue (p. 288). It is perhaps worth while to place this on record, lest it should appear that in directing attention to the danger that authority under the organised State might seek to prescribe for science the line to be taken in teaching and research, NATURE may appear to have issued a warning after the event.

There is much in the political situation of the day, even in Great Britain, which justifies Prof. Hill's fears for the future of intellectual freedom.

Physiology and Behaviour of Primates

(1) *Functional Affinities of Man, Monkeys and Apes: a Study of the Bearings of Physiology and Behaviour on the Taxonomy and Phylogeny of Lemurs, Monkeys, Apes and Man.* By Dr. S. Zuckerman. Pp. xviii+203+12 plates. (London: Kegan Paul and Co., Ltd., 1933.) 10*s*. 6*d*. net.

(2) *Behavior Mechanisms in Monkeys.* By Heinrich Klüver. (Behavior Research Fund Monographs.) Pp. xvii+387+9 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1933.) 22*s*. net.

(1) DR. ZUCKERMAN, whose previous volume on the "Social Life of Monkeys and Apes" (1932) was favourably received, has in this new work collected together the somewhat scattered knowledge relating to the 'functional' characteristics of the various types of primates, and considered its bearings upon the classification and phylogeny of the group. He deals among other things with the mechanisms of reproduction, blood reactions, the physiology of the sense-organs, and behaviour in relation to cortical differentiation.

In general, the indications supplied by these functional characters are consistent with the orthodox view of the relationships of the primates, as expressed in the commonly accepted taxonomy of the order. They do not, however, throw any very clear light upon problems of phylogeny. Zuckerman has clearly performed a useful service in bringing together much information which is not easily accessible to the taxonomist and morphologist. The book is well documented and has a good bibliography. It is illustrated by 24 plate figures of apes, monkeys and lemurs, from photographs by F. W. Bond.

It is interesting to note that Zuckerman refers with approval to the work of St. George Mivart in the 'seventies, who in spite of his anti-Darwinian attitude expressed some very sound views on primate relationships. Mivart's contention that there is little difference in respect of mental powers between monkeys and apes is one which receives some support from recent psychological research. (2) Thus in Dr. Kluver's book on the behaviour of monkeys, we find that some species, particularly of the genus *Cebus*, can utilise tools almost as effectively as Köhler's chimpanzees. This was also the conclusion of Bierens de Haan on the basis of his experiments with *Cebus hypoleucus* (1931). Actually we do not yet know enough about the behaviour of apes and monkeys to be able to rank them in order of 'intelligence', but it is significant that the more carefully and sympathetically they are studied the more complex and adaptable their behaviour appears.

Kluver's book is a contribution of the first importance to this fascinating study. It is admirably characterised by Dr. K. S. Lashley in his introduction as follows:

> "Dr. Kluver's monograph sets a new standard for analytic studies of behaviour. He has proposed the question, Just what properties in complex sensory situations are significant for the animal's reactions? and has carried out the investigation with unique thoroughness. As a result, he presents for the first time something approaching a complete picture of the perceptual world of an animal. This perceptual organisation is surprisingly like that of man. Not only are the animals sensitive to the same physical stimuli but for them also the relational properties of the situations are the same. As with man, reactions are but little dependent upon the simple physical properties of the stimulus but rather upon abstract relations which may subsist in physically unlike situations."

These valuable conclusions as to the importance of bare relations in determining responses were obtained by the "method of equivalent stimuli".

The general problem set was to pull in one of two (or more) boxes, which were differentiated from one another by some physical characteristic, as for example weight. The monkey was first trained to pull in, say, the heavier of two boxes of given weights; when training was complete the weights of the boxes were altered throughout a wide range, and it was found that the monkey almost invariably chose the heavier of the pair quite irrespective of the absolute weights. Then the appearance of the boxes was altered in various ways, but the response to the bare relation 'heavier than' was still maintained. This type of experiment, using the pulling-in technique, was extended to many other characteristics, such as shapes and colours, and most interesting results obtained.

The investigations dealt with both New World and Old World monkeys and also with a lemur; the experiments were admirably devised and controlled, and they are reported in full detail.

Scarcely less important than the experimental results is Kluver's extremely able and thorough discussion of their theoretical bearing, and his very full and careful treatment of the general principles of interpretation of animal behaviour We agree with Lashley's opinion that this discussion is "one of the most important recent contributions to theoretical psychology".

Real progress is at last being made in the study of animal behaviour, through a combination of direct and accurate observation, simple experimentation, and careful logical analysis, independent of all preconceived theory, and Kluver's book greatly furthers this good work.

E S R

Decompositions into Fifth Powers

British Association for the Advancement of Science. Mathematical Tables Vol 3 · *Minimum Decompositions into Fifth Powers.* Prepared by Prof L E Dickson (Published under the supervision of the British Association Committee for the Calculation of Mathematical Tables) Pp vi+368 (London British Association, 1933) 10*s*

SINCE 1931, when the British Association started to publish mathematical tables in volume form, three sets of tables have appeared The first comprised tables of general utility · trigonometric, hyperbolic, exponential, gamma and other functions The second issue contained Emden functions and had therefore a less popular appeal, since the tables were designed to aid in certain astrophysical researches, and the cost of printing was undertaken by the International Astronomical Union The present (third) volume, while not perhaps of such a specialised character, deals with a subject which from its nature must interest directly but a small body of scientific workers.

By the generous bequest of Lieut.-Col. A. J. C. Cunningham, the British Association has funds available to assist in the production of tables connected with the theory of numbers The scope of application of this fund would appear to be limited on one hand by the necessity of finding suitable material, and on the other by finding research workers both willing and able to produce work of the required character. In this respect the Committee is indeed fortunate in having the opportunity to undertake the printing of vol 3, the subject of which could not more clearly come under the terms of the Cunningham bequest

The actual matter of the present table concerns the solution of the Diophantine equation:

$$x_1^5 + x_2^5 + \qquad + x_s^5 = n,$$

where n is a given integer less than 300,000 and where s is to be a minimum The method of tabulation will be apparent from the following extract:

10399	0	0	1	3		10
10406	3	2	2	0	1	11

This indicates that

$$10399 = 0 \times 2^5 + 0 \times 3^5 + 1 \times 4^5 + 3 \times 5^5.$$

Thus when $n = 10399$, $x_1 = 4$, $x_2 = x_3 = x_4 = 5$ and $s = 1 + 3 = 4$ The number 10 at the end of the first row indicates that the largest integer, 10405, which precedes the next tabular entry, 10406, requires ten fifth powers, namely, the four already given for 10399 and six units, so that

$$10405 = 6 \times 1^5 + 1 \times 4^5 + 3 \times 5^5$$

From 150,000 onwards the decompositions are omitted, the minimum number of decompositions being indicated as explained above Thereafter the actual decompositions can be readily found by trial, subtracting 9^5, 10^5, or 11^5 and consulting the previous part of the table

One purpose of a table of this character is to produce experimental data in connexion with Waring's problem (in this case for fifth powers). In this problem there are two numbers of interest, m_5 and M_5; m_5 is the smallest number such that every integer is the sum of m_5 or fewer fifth powers, and M_5 is the smallest number such that from a certain point onwards every integer is the sum of M_5 or fewer fifth powers That such numbers exist has been proved by Hilbert for the general case of *k*th powers, but their actual values for $k = 5$ is not known. It is known that $37 < M_5 < 53$, the last number being due to Hardy and Littlewood. Using the present tables, Prof Dickson has proved that all integers with fewer than 484 figures are sums of 37 or fewer fifth powers and that all integers with fewer than 1,177 figures are sums of 41 or fewer fifth powers An inspection of the table tempts one to surmise the possible existence of a number $a_5 < 15$, such that almost all integers are the sums of a_5 or fewer fifth powers

The table is reproduced photographically from typescript and is very clear The author states that the elaborate checks required more time than the construction of the table

The existence of the British Association tables might become more widely known if it were possible to have them permanently listed in a publisher's catalogue L M MILNE-THOMSON.

Recent Research in Metallurgy

The Journal of the Institute of Metals (1) Vol. 50 *Metallurgical Abstracts and Index to Volumes 48, 49 and 50 of the Journal* Pp vi+962 (2) Vol. 51 Edited by G Shaw Scott Pp. 363+28 plates. 31*s*. 6*d* (3) Vol 52 Edited by G Shaw Scott. Pp 255+50 plates. 31*s* 6*d* (London · Institute of Metals, 1933.)

(1) THIS volume contains the general and non-ferrous metallurgical abstracts which have already been published during 1932 in the monthly *Journal* These abstracts not only provide the worker in physical metallurgy with an invaluable guide to the literature of the subject, but also constitute a very useful aid to the physicist or physical chemist whose interests lie in this direction As usual, the literature has been surveyed accurately over a broad front, but whether the latter is rather too broad is open to question The Institute's desire to cater for all types of its membership can be appreciated, but considerable space is taken up by abstracts of articles which are merely recapitulations of existing knowledge and practice A noticeable omission is a list of the periodicals abstracted

Although the monthly issue of these abstracts undoubtedly constitutes a great improvement on the score of rapidity of publication, considerable delay now seems to occur in their re-issue as a single volume

(2) Some thirteen papers presented at the March 1933 meeting of the Institute of Metals are collected in this volume of proceedings, together with Prof Portevin's May lecture on "The Phenomena of Quenching and Tempering in Alloys" Prof Portevin deals in a thought-provoking manner with the general principles and mechanism of precipitation hardening due to differences of solid solubility at high and low temperatures, and shows that these phenomena, far from being exceptional, are extremely common These considerations open a new field of research in the application to existing alloys of the principles of precipitation hardening.

Three papers by N. P. Allen and his co-workers deal in a fundamental manner with the practical problems of unsoundness in ingots of copper and copper-nickel alloys The recently developed tellurium-lead alloy forms the subject of one communication, and a further paper records the effects of progressive rolling reductions on the physical properties of zinc strip Two papers deal with the electrical conductivity of aluminium wire used for transmission lines, whilst other topics include the fatigue-resisting properties of aluminium alloys at elevated temperatures and the interpretation of the tensile test with reference to lead alloys Particular mention should be made of a paper by Bradley and Jones on the re-examination of the copper-aluminium system by the X-ray powder method

(3) The autumn meeting last year constituted the twenty-fifth anniversary of the foundation of the Institute of Metals, and was appropriately held in Birmingham, the original home of the Institute This volume of proceedings contains the fourteen papers presented on this occasion, together with Mr W R Barclay's Autumn Lecture on "Twenty-Five Years' Progress in Metallurgical Plant", which is illustrated with an excellent series of photographs of melting, rolling, and auxiliary equipment Probably the most interesting of the papers is Dr Rosenhain's review, prepared at the request of the Council, of progress in non-ferrous metallurgy during the life-time of the Institute. Much metallurgical history has been made in this period, and Dr Rosenhain briefly surveys a number of developments, including the improved equilibrium diagram technique, the study of deformation and fatigue, the application of X-ray methods, and the development of light alloys and of special cutting alloys, with many of which he and his students have been intimately connected.

Research on precipitation hardening is represented by two papers, both dealing with copper-nickel-aluminium alloys, and a further contribution from Allen concerns the distribution of porosity in aluminium and copper ingots. Other papers deal with the preparation of lead alloys for microscopic examination, the protection of magnesium alloys, the annealing of copper wire and the corrosion-fatigue characteristics of an aluminium specimen consisting of two crystals. The papers and ensuing discussions testify to the value of the past twenty-five years' work of the Institute in the stimulation of the study of alloys.

L. B. H.

Short Reviews

Recent Advances in Agricultural Plant Breeding By Dr H Hunter and Dr H Martin Leake Pp x+361+16 plates (London. J and A Churchill, 1933) 15s

DURING the past generation the expansion of plant-breeding work on agricultural plants has been so rapid that it is impossible to present even a condensed comprehensive review within the limits of a single volume Recognising this, the authors have confined their attention to the results of the more important investigations which have emerged from the academic stage and have resulted in improved varieties that have passed into general use Indications are given of the general direction of progress and of some of the main problems awaiting solution

Attempted improvements are often determined by commercial requirements, which may vary not only from one country to another, but also within each country itself Further improvement in plants is relative to the environment, as soil fertility and climate, and is not an absolute condition, for example, a new variety that gives excellent results in one area, or under certain manurial treatment, may show no advantage elsewhere or under different cultural conditions The extreme difficulty is recognised of arriving at a truly homozygous unit giving a completely stable plant, and the indications adduced from practice are that stability is in reality a relative term, but that some varieties are more stable than others

Work in temperate regions is chiefly on food crops, with species and varieties long under domestication The range of sub-tropical and tropical crops is much wider, and many of them are much nearer their wild forebears, thus raising very different problems in improvement Under tropical conditions, also, environmental conditions encourage disease so much that the evolution of disease-resisting types takes precedence even of yield and quality improvement.

The survey is suggestive and its usefulness is increased by the provision of illustrations and numerous references associated with the individual crops

Geology By Prof William H Emmons, Prof George A Thiel, Prof. Clinton R Stauffer and Prof Ira S. Allison Pp xii+514 (New York. McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd., 1932) 24s net

THE collaboration of four professors in the production of an introductory textbook of their subject must be a rare event In this present instance the experiment, if it may be called such, has been successful, for the result is a lucid and logical exposition of the principles of geology The greater part of the work deals with geological processes and is uniformly excellent. American examples are mainly employed for illustration, but the subjects are usually so magnificent that such a choice is right.

The last half a dozen chapters of the book are concerned with the origins of mountains, metamorphism, rock structures, conditions within the earth, earth history and kindred subjects Here the treatment is not quite so successful The account of the origin and structure of mountains, for example, is sketchy, and the references, especially to the Alps, distinctly inadequate. Again, the grand unity of metamorphic processes —the only guiding light in this uncharted sea—is obscured by a needless subdivision of the subject Further, the planetesimal theory of the origin of the solar system is presented without critical examination But, in spite of this, the book is certainly a good modern introduction to the subject and would be useful as a supplementary text for British students In the main it is written in a pleasing easy style that is remarkably uniform throughout the volume The illustrations, nearly five hundred in number, are well chosen and well reproduced

Basic Units in Mechanical Drawing By Prof Randolph Philip Hoelscher and Prof Arthur Beverly Mays Book 1 Pp viii+289 (New York John Wiley and Sons, Inc, London· Chapman and Hall, Ltd, 1933) 10s net

THE preface sufficiently indicates the design of the book, and the accompanying text throughout bears testimony to the realisation of that design. The authors are to be congratulated on being able to present the results of their practical experience in an eminently practical form Nor can the diagrams, which are so liberally furnished, be over-praised.

The jejune qualities so frequently apparent in books of this nature are herein totally absent If a demurring criticism is due, it is in respect to the somewhat mechanical system of lettering advocated, preferably lettering should be introduced upon a freehand mode of treatment

P L M.

Collision Processes in Gases By Dr F L Arnot (Methuen's Monographs on Physical Subjects) Pp viii+104 (London Methuen and Co, Ltd, 1933) 3s net.

THIS useful little volume deals with that group of collision phenomena in gases in which the processes may be treated as individual events. It is divided into two parts. The main section deals with collisions between electrons and atoms and the brief second part gives some account of collisions between photons and atoms, and between normal, excited and ionised atoms

The book is lucidly and critically written and may be unreservedly commended A F.

Thomas Young

By Sir Joseph Larmor, F.R.S.

It is a welcome feature of the times that interest in the great pioneers who created the science of mathematical physics in Great Britain shows signs of revival The recent publication of a biographical sketch of Thomas Young by Mr Frank Oldham[*] is an indication At the time of his decease (1829) at the age of fifty-six years, the task of collecting and editing Young's later scientific writings passed into the hands of George Peacock, Dean of Ely and Lowndean professor at Cambridge and though through pressure of business at Cambridge and Ely he took twenty years over the work, the result in two volumes on physical science, with a third on hieroglyphical research, and the indispensable standard biography as a fourth, is, or ought to be, in a proper scheme of things, one of the permanent classics of natural knowledge It reveals the editor, known as one of the introducers of the formal Continental analysis into Cambridge, as an adept critic in general Natural Philosophy of the Newtonian type as well

In those early days scientific people did not write numerous treatises, and as a result, into their work, as intended for permanence, they put their most sustained thought The nascent separate sciences had moreover then to be systematised, and they were not seldom, just as now, knocking up against mutual discrepancies that demanded both unrelaxing effort and a safe provisional judgment Even in pure theory the preparation of the immortal "Mécanique Analytique", a systematising treatise of no great length or abstruseness, built on historical foundations, occupied a long time, and is said to have so exhausted Lagrange that he had to desert mathematical science for several years We may contrast with this the stupendous achievement of Isaac Newton, who, in spite of irritations from which he was far from immune, managed under stimulus to prepare the "Principia", in part doubtless from material which already he had by him in some form, in eighteen months The formal legacy of British physical theorists of about a century and a half ago, especially in the Scottish universities, mainly developing out of their formal courses of lectures to large audiences, and thus not infrequently posthumous as in the cases of Black and Robison, produced a species of literature tending, except in the hands of masters, to be either superficial or dull The greatest and most original of all general lecture courses was Young's "Lectures of Natural Philosophy and the Mechanical Arts", over which there was certainly no delay, as the two massive and very complete yet concise quarto volumes were published (1807) at the age of thirty-four years a few years after the course was delivered

Was it the very universality of Young's range of interests that saved him from premature mental exhaustion ? One of the three volumes of the 'miscellaneous works', edited for Peacock by his friend John Leitch, is taken up with philological studies, largely exhibiting his connexion with the early history of the cardinal advance in wide fields of knowledge rendered possible by the deciphering of the Egyptian hieroglyphics, which was first brought into Young's keen attention by the problem presented by a tri-lingual inscription on the Rosetta stone. The controversy as to the rival merits of Young and his contemporary Champollion of Grenoble, who seems to have come later into the field, doubtless far more learned in the cognate Coptic and other sources, has fluctuated ever since. The writer of the biographical sketch which suggested the present notice follows Leitch's account, and also Peacock's in an independent and trenchant analysis in the "Biography" (pp 258–344), in assigning the main credit to Young but one has a feeling that in that decision they are not in the swim The claim asserted for Young on his monument in the Abbey is that he was the first to penetrate the obscurity that veiled for ages the problem of the hieroglyphics of Egypt and, however the complete final solution be apportioned, this statement appears to hold good On reference to the last edition of the "Encyclopædia Britannica" one finds the balance struck emphatically for Champollion, in agreement as is there stated with universal authority · this may be right enough so far as the general reader can know, but even a cursory inspection of Peacock's account of progress indicates that there is more that might properly be said indeed, the name of Young is not even mentioned either under the heading "Hieroglyphics" or under the personal notice of Champollion Even more remarkable, surely by one of the workings of fortune which the Greeks named Nemesis, in compensation for his supreme classical contributions to the original "Encyclopedia", the name of Young occurs only in a secondary way in the general index to the new volumes , yet one of his own most notable works is the long series of scientific biographies which he contributed with much research to the Supplement of the early publication.

Young is still perhaps popularly known mainly from the episode of his personal collisions with the youthful Brougham, who was afterwards for some time Lord Chancellor of England. The latter, then editor of the *Edinburgh Review*, from its political and literary connexions an influential organ of opinion, avenged himself for some slighting incidental criticism of his own writings, of a kind to which Young was perhaps too much addicted, and at the same time acquired for himself a unique species of scientific renown which has clung to him, by gibbeting, in eloquent and even scurrilous terms, the revival of the wave-theory of light and its brilliant developments in many directions through Young's recognition of the principle of interference of trains of waves, which ought to have been so obvious to a real student His satire is commonly held to have diverted men from any attentive consideration of the new discoveries, by discrediting their author, and so as is said managed to postpone the progress of optical science for twenty years But that is possibly ascribing to him too much credit : Young had already become and for long remained Foreign Secretary of the Royal Society, and maintained his repute with his colleagues there, though at that time they were scarcely mathematical enough to become deeply concerned in his own researches He was moreover to receive a remuneration for the copyright of his "Lectures" handsome for that time, ultimately however owing to bankruptcy unpaid : though the book was to contain a very elaborate and expensive reprint of the great memoirs that were supposed to be discredited.

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[*] "Thomas Young, F R S , Philosopher and Physician " By Frank Oldham Pp. 159+2 plates. (London . Edward Arnold and Co , 1933) 6s. net.

Young's dignified rejoinder to Brougham's abuse, published as a pamphlet, is a valuable personal record of his mode of work, though the provocation by itself had scarcely called for such serious notice he complains that only one copy of it was sold, but possibly its main function may have been for private distribution to his competent scientific friends Lord Brougham himself had less equivocal merits in other directions, especially in educational zeal, after he had been ejected from political life by his temper He appears to have been prime mover in establishing the "Society for Promoting Useful Knowledge", which succeeded in engaging some of the best scientific intellect of the time in works of general interest yet precise scientific value , for example, it produced a series of biographies which have now fallen into undeserved oblivion, and even succeeded in circulating in periodical instalments, almost in modern fashion, standard treatises of the highest rank, such as De Morgan's "Differential and Integral Calculus". How far the "Encyclopædia Metropolitana", the high-water mark of the science of its time, and the ancillary more popular volumes such as Sir John Herschel's once famous "Introduction to the Study of Natural Philosophy", so helpful to the nascent inductive logic, may have been a further outcome, we may not stop to inquire Indeed the general public neglect of which Young complained must largely have been his own fault, through his persistence in anonymous publication in brief notes, in the interest as he thought of his medical practice, which would naturally detract from the attention which was his due. His speculations, as lying outside the range of the main interests of his colleagues, and of the public of the time, had appealed coldly to them · and he appears moreover to have been a silent man,—he relates in a family letter that he was stimulated by a remark at an annual meeting of the Royal Society that "no one had heard him make a speech". The resurrection of his public fame in a later generation was largely the result of a judgment opening out to a wider audience, by Helmholtz, who had first encountered his early keen *aperçus* in the course of his own activity in the physiology of vision. Helmholtz characterised him as largely misunderstood because he was too far in advance of his times, a modified version of the perhaps natural explanation that his habits of exact thought were too concise and interwoven to permit him to give explanations at length without distracting his own attention from the concatenation of his ideas He relates that his ideas on light gradually arose from study and experiment on the phenomena of waves of sound, which occupied him and mystified his neighbours during his three years residence at Emmanuel College in Cambridge, keeping terms with a view to a medical degree The customary rather silent appreciation of his matured genius by his own British school, men such as Airy and Maxwell and Rayleigh, has not been wanting.

In another episode in his unfortunately controversial career, in relation to yet another of the fundamental physical doctrines, the principles of atomic interaction in relation to capillary phenomena, the part of Brougham was played to some extent, though with amends later, by none other than the illustrious Laplace As an offset to mathematical genius and great industry, the world has been accustomed to accept, possibly to exaggerate, Laplace's propensity to annex information for his systematic treatises from where he could find it, and modify it at will, without any great scruples regarding original discoverers If he did take over Young's ideas, he made a more artistic work of them though a student with physical instincts will probably still prefer to try to absorb the wide and often sufficient simple *aperçus* of Young before passing on to the special analytical elaboration of Laplace An illustration of the contrast is that, in a domain where Laplace is perforce silent, Young's more flexible, if somewhat obscure, train of thoughts on the relation of surface tension to molecular interaction at sensible range, manages to give him a provisional estimate, lightly held however, of the diameters and range of activity of atoms, perhaps the earliest effective attempt in that direction, as Lord Rayleigh remarked, one which though real now appears in the detailed lights of modern science to be about a hundred times too small the brief systematic expansion of such estimates of atomic size, as probed in all directions at the hands of Lord Kelvin, became a remembered incident when it appeared long after. Yet though Laplace's propensity to taking new general ideas for granted, especially when not fully developed, strongly irritated Young, with his memory of previous experience at the hands of Brougham, it had not, to take a different type of instance, prevented most friendly rivalry and combined continuous co-operations for years between Laplace and Lagrange, calm amid the turbulence of the times, in establishing and confirming the very delicate amenities of the planetary system, and incidentally indicating, starting therefrom, much of the modern analytical structure of general dynamical science. The simplicity and dignity of Lagrange's character appear indeed to have placed him entirely outside the reach of priorities or envy.

Young's work collided with the dogmatism of Laplace also in another domain. A particularly attractive and engaging episode in the history of science is the friendly rivalry of Young with his youthful French contemporary Fresnel, in exploring the mysteries of double refraction by crystals, which it is a great merit of Peacock's biography to have brought out from the original letters. A sentiment relating to these problems, with which Young had wound up an earlier exhaustive classical article "Chromatics" ("Encyc Brit" 1817. 'Works', 1, 342), merits quotation as not inapplicable to cognate mystifications in the modern world of physical speculation, especially as its pessimism was so soon to be wholly dissipated:—

> "and the greatest difficulty of all, which is to assign a sufficient reason for the reflection or non-reflection of a polarized ray, will probably long remain to mortify the vanity of an ambitious philosophy, completely unresolved by any theory".

However, Laplace had proceeded to annihilate in advance both Fresnel and Young by an elaborate deduction of double refraction from the orbital dynamics of Newtonian light-corpuscles, by an application of the general Lagrangian doctrine of Least Action: a most astonishing analytical performance, which was promptly demolished with some heat by Young, by the acumen of simple direct reasoning, and in the first instance in the popular *Quarterly Review* of all places. Here again contemplative insight asserted its mastery, as regards general ideas, over merely formal algebraic development. But this remonstrance in turn betrayed Young into a characteristic depreciation (*vol. 2, p. 567, deprecated by Peacock*), with scarcely a word of recognition of the beauty of the processes, of the method of variations, Lagrange's earliest and most fruitful discovery, which has largely been the path of analytical progress in modern physical science:

> "The steps of the method are generally simple and easily understood, at least they may and ought to be rendered so: but the merit of the invention is none the less because it admits of a very ready application and because it might have occurred to a less distinguished mathematician."

There are many other indications of Young's intuitional acquaintance, often lucid and informing, with the nascent general Continental analysis, which he was even at some pains to dissemble.

About half the second volume of the "Lectures" is occupied by a catalogue of the mathematical and physical sciences of the eighteenth century, which had completely occupied its author for three years: he obviously had examined at first hand all the works of the masters, as is evidenced by the rapid remarks, often very illuminating, sometimes deprecatory of the delay in reaching concrete results, which he appends. For his instincts were Newtonian, aiming directly at a general view of the order of Nature. But though the modes of thought born out of direct wide contemplation of Nature appeared to advantage as against the mode of early translation into abstract algebra, yet the Newtonian procedure in its other aspect, inevitable in his day, of special calculations *ad hoc*, failed, at times conspicuously as Young's work was often to illustrate, in elegance and in interest even when effective in reaching a result. Such provisional procedure could never have originated the brilliant indirect algebraic analysis, going far beyond immediate objects, and opening up novel intuitional fields of thought, which had perforce to be constructed gradually, long after Newton, for the progress to minuter detail of the relations of dynamical astronomy, the most coherent and exact of the sciences and historically a pattern for them all. No such authoritative catalogue, even of the select classical works of modern science, of personal origin, is likely to appear again.

This example of the impatience of Young contrasts with the eager personal appreciation of the algorithm of variations, in personal correspondence with Lagrange, then less than twenty years of age, by Euler, the greatest analyst of modern times, who had been himself engaged not very effectually, also on a physical basis, with the same range of problems. Of course, like all fruitful ideas, this principle reduces to a manageable simplicity once it is carefully systematised. Thus in arithmetic the supreme discovery of the Hindu philosophers, of a decimal scale, nine digits and a zero, with values determined by position, which now every child must learn, became, when passed on to the Western world through the Arabs, the starting point which rendered possible all progress in scientific calculation: and the doings of Pascal with a Torricellian vacuum tube on the Puy de Dôme promoted, perhaps completed, the consolidation into common form of the originally intricate Archimedean notion of fluid pressure. So too the mere notational scheme, or algorithm, of the variational method was a new jumping-off point for the mathematical physical analysis from which it had derived its inspiration: though the formal Calculus of Variations may be now wandering, in hope doubtless of ultimate consolidation, into complexities of functionality far removed from the smoothness which is sufficient for applications to atomic structures, unless as in quantal theory finite variations have to come into account. It is not surprising that Young was strenuous as to the superiority for educational purposes of logical study and illustration of general elementary principles taken over a wide range, prior to any undue premature absorption into specialisations for which a life-time would later be available. Thermodynamic concepts are an uncompleted modern instance of the transition from abstruse to elementary.

This is scarcely a suitable occasion to refer to

Young's extensive professional writings in the nascent sciences of medicine, which, perhaps not unjustly on the whole, have become neglected But his Croonian lecture, unearthed from them by Peacock, as delivered to the Royal Society soon after he had got the two volumes of "Lectures" off his hands, dealing with propagation in the arteries, in relation to the elastic pulsation through the perhaps perfect elasticity which surely must in the final causes of the organic world subserve some function, was a subject of pure hydraulic science in which he became, afterwards at any rate, very competent, with regard to which the last word has perhaps scarcely yet been said

Young was also closely and most effectively, yet as usual most concisely, concerned with the problems of geophysics, such as the tides and the figure of the earth, also with the statistical doctrines of insurances and the duration of life the former from his prominent official connexion with the Board of Longitude, the latter from his position as adviser to a life insurance society

A judgment, near the end of his life ("Biography", p 483) on the merits, as regards fruitful discovery, of various modes of intellectual training and investigation, is characteristic and perhaps still authoritative Dr Young's opinion was

> "that it was probably most advantageous to mankind, that the researches of some enquirers should be concentrated within a given compass, but that others should pass more rapidly through a wider range—that the faculties of the mind were then exercised, and probably rendered stronger, by going beyond the rudiments and overcoming the great elementary difficulties, of a variety of studies, than by *employing the same number of hours in any one pursuit*—that the doctrine of the division of labour, however applicable to material products, was not so to intellect, and that it went to reduce the dignity of man in the scale of rational existences".

His own astonishing scientific record, combined with very remarkable erudition in classical literature and general philology, and even with an assiduous cultivation of the Graces which in early life tended to make up for the austerities of a Quaker training, forms a remarkable example, surely nearly unique, of what can be achieved by mental industry, working largely inward on itself, and, one may add, it offers an incentive to the biographical exploration, as a chapter in the newer psychology, of the methods of thought of the pioneers in discovery, which in our nation has been none too keen

Infra-Red Photographs of Racial Types

By PROF C G SELIGMAN, F R S

MORE than a year ago, I received from Mr. L Bloch, of the Ilford Research Laboratories, a number of photographs—'couples' of dark-skinned subjects, all or mostly negroes—taken by ordinary and by infra-red light The difference in appearance is very remarkable on one hand the normal photograph, on the other such striking modification in colour of face and often pattern of clothing that a close examination is necessary to realise that the two prints are photographs of the same subject The most remarkable feature is that under the infra-red rays the normal dark skin of the negro appears of a waxy white pallor This is so striking and renders the two photographs of the same face so unlike each other that the suggestion was made that the infra-red photographs exhibited Mongoloid characters not obvious in the prints taken under normal conditions This, however, is not so, nor are any Mongolian characters observable in the infra-red prints of a much longer series of negroes and other 'coloured' men which have recently been submitted to me. The idea perhaps originated in the somewhat deep-set appearance of the eyes seen in many subjects in the infra-red prints Examination shows that this is an expression of the obliteration in the infra-red photographs of a considerable amount of the finer facial modelling, due largely to the loss of shadows and the finer gradations of tint Those who have not a series of photographs for reference will best appreciate the change by examining a photograph published by Dr S. O Rawling*, in which oranges, apples, tomatoes, and dark cherries, on a plate with a polychrome design, appear as if the whole were modelled in pale-coloured wax, no trace of the design being visible

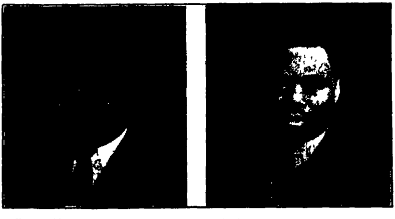

FIG 1 Photographs with panchromatic (left) and infra red (right) materials of a West African Negro (Temne) Note the waxy pallor of skin and lightening of irides, there is absence of the finer modelling but the unirrupted hairshafts show up through the superficial layers of skin

There are two interesting and curious features in these infra-red photographs of coloured men, though neither is of racial significance (Fig 1) Owing to the general lightening of colour, even the darkest eyes appear light, their irides as seen in the infra-red print appear of the same colour as blue-grey eyes in normal photographs The other peculiar feature is that it is often possible to trace the appearance of a beard and moustache in prints of clean-shaven men, due to the human skin having its maximum transmission in the region of the infra-red, so that the hair follicles with their contained hair shafts show up as darker shading

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* "Infra-red Photography" (1933), p 34

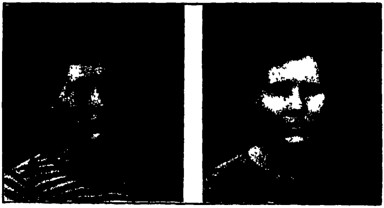

FIG 2 Photographs with panchromatic (left) and infra red (right) materials of a white girl (Nordic type), hair, very fair, eyes, blue grey complexion, very fair, wearing blue and white striped jumper

In the photographs of the white race, relatively few in number, some of these results are reversed (Fig 2) There is the same waxy pallor of the skin in the infra-red prints, and freckles are obliterated, but the eye colour changes in the opposite sense Instead of being lightened, eyes described as blue appear dark, so as to suggest deep hazel or medium brown On the other hand, in an infra-red print of a man whose eyes are described as brown, the irides are if anything a shade lighter than in the normal photograph, thus approaching the lightened colour of infra-red prints of the eyes of the dark races The normally dark eyes of a Japanese appear in the infra-red print about the same shade as the blue-grey eyes of a typical Nordic In Europeans the less dark shades of hair may appear considerably lightened, just as the leaves of trees present a white, almost frosted, appearance in infra-red photographs

To sum up the differences in the normal and infra-red photographs of the varieties of *Homo*, though striking at first sight, do not appear to present any features likely to be of use to the anthropologist, they are, indeed, of photographic rather than anatomical interest

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Heavy Hydrogen[*]

By SIR J J THOMSON, O M, F R S

THIS lecture is on reminiscences connected with the Royal Institution, so that accounts of quite recent discoveries would not be within its scope There is one subject, however, which is now attracting a good deal of attention—heavy hydrogen—which satisfies both conditions, it is a reminiscence and it is connected with the Royal Institution In 1911 I gave a Friday evening discourse "On a New Method of Chemical Analysis" By this method each kind of gaseous particle in a vessel through which an electric discharge is passing produces its own parabolic curve on a photographic plate Thus if the vessel contained a mixture of hydrogen, oxygen and nitrogen, there would be six parabolas corresponding to the atoms and molecules of hydrogen, oxygen, and nitrogen respectively, along with others due to each of the compounds formed by these elements The mass of the particle which produces any parabola can be determined from the position of the parabola

Using this method, I detected the presence of a parabola which must have been produced by a particle of mass 3 (the mass of the hydrogen atom being taken as the unit) I obtained it first when the gas in the discharge tube was hydrogen prepared in the ordinary way, but its appearance was very capricious, and only occurred in a small percentage of the experiments I found, however, that if instead of using ordinary hydrogen, I used the gas given off by certain solids when bombarded with cathode rays, the (3) parabola appeared with great regularity The amount of the gas producing it varied with the nature of the solid bombarded, but there were few minerals or salts among those I tried which did not give traces of it, potash (KOH) is a very convenient source and a specimen of black mica given to me by Sir James Dewar gave an exceptionally large supply

I obtained the active gas also by deflagrating a very thin wire by passing a very large current through it, or even by raising a wire to bright incandescence This indicates that the bombardment by cathode rays does not manufacture the gas but merely liberates it from the solid

I made a very large number of experiments on the gas obtained in this way, the results of which were published in the *Philosophical Magazine* and summarised in my book "Rays of Positive Electricity" (Longman) One important property of this gas is that it can be stored after bombardment and tested long after it has been produced, showing that it is a stable gas and can exist in an uncharged state In fact, the persistence with which it clings to the walls of the discharge tube and the cathode makes experiments troublesome, as when once the tube has been used for this gas, it will continue, after the gas has been pumped out and replaced by another of a different kind, to show the (3) parabola , long sparking with oxygen in the tube is required to get rid of it

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[*] From a Friday evening discourse delivered at the Royal Institution on February 9

I made many tests of the chemical properties of this gas and found that under them it behaved like ordinary molecular hydrogen Thus, for example, it disappeared after vigorous sparking in the presence of oxygen, or when passed slowly over red hot copper oxide , again like hydrogen it can pass through red hot palladium , and there was evidence that when an electric discharge was passed through it, some of its molecules were split up into a positively charged hydrogen molecule and a negatively charged hydrogen atom

Through the kindness of Lord Rutherford, I have had the opportunity of examining by the positive ray method samples of 80 per cent concentration of heavy hydrogen prepared by recent methods Very interesting photographs obtained with heavy hydrogen of less concentration have been published by Prof P Zeeman So far as I can see, the heavy hydrogen behaves in just the same way as the form of hydrogen obtained by bombarding solids With these high concentrations, so much heavy hydrogen adheres to the walls of the tube, that instead of trying to get rid of it by bombarding with oxygen, it saves time to make a new tube for each experiment Again, with the highly concentrated gas, I found, as Prof Zeeman had done, parabolas corresponding to H_4 and H_6 , in my early experiments a parabola (4) was frequently seen along with H_3 I ascribed it to helium and probably some of it was due to this source, but now I think part of it was due to H_4 , on a few occasions, too, I observed a line corresponding to H_6 The evidence seems to me to leave little doubt that the gas I called H_3 more than twenty years ago is the same as that which is now called heavy hydrogen

I said in "Rays of Positive Electricity" that from my experiments I suspected that there might be two kinds of H_3 , this surmise is confirmed by the fact that many chemists who have experimented on tri-atomic hydrogen have come to the conclusion that it has a life of only a minute or so, and can only exist when charged with electricity So far as I know, they all used hydrogen prepared in the usual way and not that obtained by bombarding solids , there is not the slightest doubt that the H_3 obtained in this way is stable and can exist uncharged

I think the effect of the solid is due to its adsorbing a mixture of gases including H_2 and H_3, and that when it is bombarded, relatively more H_3 than H_2 comes off from the adsorbed layers Thus the mixture that comes out is richer in H_3 than the mixture in the gas adsorbed by the solid

Obituary

SIR WILLIAM HARDY, F R S

THOSE who enjoyed Hardy's friendship, and even those who could hope for no more than occasional contact with him, will deeply feel the loss of a strong and vital personality radiating an influence which stimulated effort, cured discouragement and could reawaken flagging enthusiasms Hardy entered into everything he did with zest, and this seems to be the word which adequately describes his own attitude to life He met each successive experience with fresh interest, and brought his whole nature to the appreciation of whatever it offered of value His enjoyment of intellectual pleasures was itself almost sensuous, while his delight in the beauties of Nature, or in the appeal of fine pictures and music, was always mingled with—and, for him, intensified by—the intellectual reactions they evoked Life's minor pleasures appealed to him and he loved a good wine, and a good story, in the telling or the hearing, and he enjoyed both best in good company

Surpassing Hardy's many other enthusiasms was —as all his friends know—a passion for the sea and the adventures it provides for all good sailormen like himself Research stood high among his pleasures , he would literally smack his lips over some happy occurrence in a test tube, but probably the highest note in the gamut of his enjoyment was evoked by a boat with full sails, a spice of danger, and with the good ship answering to his hand on the helm

Some insistence upon this lusty side of Hardy's temperament is essential to any proper understanding of him as a man , but while he savoured all pleasures so keenly, his outlook was far indeed from that of the mere hedonist , his life was full of serious purpose, and no less full of accomplishment and service

I myself came first to know Hardy in 1898, when he was in his thirty-fourth year His scientific training had been that of a biologist, and at this time he was on Michael Foster's staff in the Physiological Laboratory at Cambridge He was, in particular, responsible for the teaching of histology to the advanced class, and had engaged in histological research He had published, alone and with others, several papers describing highly original work on wandering-cells, and *inter alia* on the nature of the attack of oxyphil blood cells on bacteria

Just before I became a member of the Cambridge staff, Hardy had convinced himself that current histological methods were employed with too little discrimination, and that many of the structures supposed to be characteristic of protoplasm were no more than artefacts produced by the action of reagents during the preparation of tissues for the microscope. Once assured that this might well be the case, he set himself with characteristic energy to investigate the matter. He was thus led to study aspects of the colloidal state in relations but then little known, and to deal with problems remote from his previous experience. He worked with the simplest of equipments, yet he rapidly brought significant facts to light. I was fortunate enough to occupy a room adjacent to his, and witnessed the progress of his research and the joy it gave him.

In 1899 Hardy published two classical papers "On the Structure of Cell Protoplasm" and "On the Coagulation of Proteid by Electricity". These titles do not convey the full significance of the work they describe. The clarity with which the existence of two types of colloidal dispersion was demonstrated, and the precision the work gave to the relation between electrolytes and colloids with its dependence upon ionic and micellar charges, together with other points of much importance described in these publications, made them extraordinarily influential. They stimulated work by scores of others and greatly accelerated the progress of colloidal chemistry.

Hardy retained to the end of his life an interest in this and kindred aspects of knowledge. He was specially curious as to the nature of the protein equilibrium in blood, and in the precise nature and meaning of the globulin fraction. Had he lived to deliver his address as president of the British Association, I believe that part of it, at least, was to be devoted to the results of his later thought on such questions.

The period of Hardy's researches to which I have been referring was of much significance to him. It led to his general interest in physical chemistry, and determined a direction for much of his later thought and work, his highly original dealings with the influence of chemical constitution on surface tension, for example, and the later developments which followed upon them.

In his earlier days as a physiologist, Hardy did not especially concern himself with metabolic phenomena, or with nutritional questions. The formation and management of the Royal Society Food (War) Committee, which fell to him as the biological secretary of the Society, awakened his interest in such matters and prepared him for the important work he was to do in later years as chairman of the Food Investigation Board.

Hardy's mind was but little trammelled by tradition, or even by the orthodox views of the day. His thought always worked on original lines. He was indeed no industrious reader of current scientific literature, seeking rather for the known facts whenever he wanted them for a specific purpose. This circumstance, and the great variety of his interests, together with his constant choice of the simplest possible technique in research, displayed qualities more often possessed by brilliant amateurs than by professional workers in scientific fields. One of the reasons for the success of his highly personal work was the freshness of mind that he brought to every problem, and the ingenuity with which he contrived his own simple, but adequate, experimental methods.

Hardy's genius had free play in the laboratory, and pure science has doubtless suffered from the fact that his latest years gave but little opportunity of displaying it there. One would be rash indeed, however, to suggest that he should have been spared from the administrative duties which he fulfilled so admirably and so greatly to the advantage of his country.

F. GOWLAND HOPKINS.

BY the death, on January 23, of Sir William Bate Hardy, at his home in Cambridge, in his seventieth year, science has lost a great captain and Great Britain a great public servant.

Hardy was educated at Framlingham and at Gonville and Caius College, Cambridge, where he was elected to a fellowship in 1892. He was Shuttleworth scholar in 1889, and Thurstonian prizeman in 1900. He was first and foremost a biologist, taking zoology in the Tripos, and then turning to physiology, and particularly to histology, a subject which he taught and in which he did research in Michael Foster's laboratory. To the end of his life he never lost his love of the microscope, and it is not many years since that he spent uncomfortable hours at a temperature of − 12° C. in one of the cold chambers at the Low Temperature Research Station, following through the microscope the process of freezing in gels.

From histology Hardy passed to the study of the colloidal state, a field then new and one in which he did pioneer work. No event in later life gave him more pleasure than to take part in the meeting at Cambridge in 1930 called by the Faraday Society to discuss the biological aspects of colloidal science. His scientific interests constantly broadened, and turning to the problems involved in action at surfaces, he entered the field of lubrication, and became a recognised authority on boundary conditions, contributing an article on the subject to the "Dictionary of Applied Physics". He was also Chairman of the Lubrication Research Committee of the Department of Scientific and Industrial Research.

The work for which Hardy was best known was, however, that which he did from 1917 onwards in the service of the Department of Scientific and Industrial Research as first chairman of the Food Investigation Board and as Director of Food Investigation. Here he found a new field that gave full scope for the exercise of his truly remarkable powers as leader and inspirer of a team of research workers, as advocate of the need for more science in industry and as apostle of co-operation in research between the members of the British Commonwealth of Nations. It was appropriate that the direction of the work should be in the hands of a biologist, for Hardy was never tired of stressing the logical priority of biology over engineering where the transport and storage of food is concerned

Research, to Hardy, meant essentially the untrammelled research of the university laboratory, carried out to satisfy that intellectual curiosity that he himself displayed so pre-eminently, and he never wavered in his conviction that no solution of a practical problem was worth while unless it was based on an adequate knowledge of the fundamental science that lay behind it, and therefore that it is the man with a sound training in academic research who is best fitted to unravel the practical problem and reach that solution The work described in the annual reports of the Food Investigation Board, and in the numerous other publications that came from his three research stations, the Low Temperature Research Station, the Torry Research Station and the Ditton Laboratory, bears witness to this insistence on fundamental research, and the success he had in solving practical problems and in gaining the confidence of the whole food industry were his complete justification Such achievements as the gas-storage of fruit, the long-range transport of chilled beef and the brine-freezing of fish were not fortuitous, but rather the inevitable outcome of much patient work of a fundamental character

Hardy, however, was not one-sided While he unerringly picked men capable of academic research, and saw that they had the opportunity and the means of doing it, he equally insisted that they learn the practical details of the industry they served, for he knew that only so could they gain the confidence of industry and, when the time came, apply their academic knowledge to the greatest advantage.

To-day, when the storage and transport of foodstuffs is so rapidly being put on a sound scientific basis, and when new developments are taking place in all directions, it is fascinating to go back and read the original memorandum which he, Sir John Farmer and Sir William Bayliss prepared in 1917 for the Advisory Council for Scientific and Industrial Research One marvels that one man in so few years could achieve so much, and one realises Hardy's tremendous power The original membership of the Food Investigation Board was strong, it comprised Sir Kenneth Anderson, Sir Joseph Broodbank (Hardy's successor in the chair), Sir Walter Fletcher, Sir Thomas Mackenzie, Sir Richard Threlfall and Prof. T B Wood What they thought of him may be illustrated by a remark of Threlfall's—"Hardy, you must treat us like your umbrella—to be kept rolled up out of the way, and brought out only when a storm comes"

Hardy's other great interest in later years was marine research. On his advice, the Development Commissioners appointed an advisory committee for fisheries research under his chairmanship This committee drew up a programme which was adopted by the Commissioners, whilst at the same time the committee was made permanent and for nine years Hardy remained its chairman The breadth of his view and his practical knowledge, as well as his personal familiarity with the special difficulties of work at sea, were of inestimable value His penetrating understanding of their work and his constant help and sympathy were a source of inspiration to the biologists and hydrologists engaged in the investigations. Especially he realised that no practical results could be looked for until a large amount of fundamental research had been done, not only on the life-histories of the marketable fishes themselves, but also on the physical and biological conditions under which they lived Not only the changes in the chemical constitution of the sea-water from season to season and from year to year, the variations in tides and currents, the influence of light, must be known, but also the inter-relations of the whole flora and fauna which form the fundamental food of the fishes require detailed study. This work throughout had his earnest support and sympathy

Many honours came Hardy's way, and he wore them with the simplicity that characterised his whole life In the academic sphere, he was elected a fellow of the Royal Society in 1902, served as secretary from 1915 until 1925, and was Royal medallist and Croonian and Bakerian lecturer of the Society Oxford conferred on him the honorary degree of D Sc, and Aberdeen, Birmingham and Edinburgh that of LL D In 1931 he was invited to the United States of America and delivered the Abraham Flexner lectures at Vanderbilt University At the time of his death he was president of the British Association for the Advancement of Science In the wider sphere he was a member of the Economic Advisory Council, and of the Advisory Council for Scientific and Industrial Research, president of the British Association of Refrigeration, a Trustee of the National Portrait Gallery, and a member of the Governing Body of Charterhouse and of the Leverhulme Trust Committee He was knighted in 1925.

Hardy's lay interests were as varied as his scientific interests Salt-water sailing was a passion with him, and he owned a succession of small yachts which he sailed regularly He was a good naturalist, with a wide and intimate knowledge of plants and birds Music and archæology also claimed his time Bridges' "Testament of Beauty" became his constant companion on its publication, and he was an enthusiastic 'Janeite'

Hardy was a big man in every way Big in body, with a fine head and big, capable, sensitive hands—craftsman's hands, instinctively one knew him incapable of anything small or mean With this bigness went utter simplicity and honesty of purpose, an inexhaustible fund of enthusiasm and great warmth of heart, such a combination was irresistible

He married in 1898 Alice Mary, daughter of Mr G B Finch, who survives him, with his son and his two daughters

News and Views

The King of the Belgians and Progressive Science

A GREAT figure of the War has passed away with the death on February 17 of Albert I, King of the Belgians, at the early age of fifty-eight years For nearly twenty-five years he guided his people faithfully, carrying them with him through the War years, urging them on and directing their progress during the not less uncertain years following the Peace of Versailles His work in the political field has been set forth in many places We are concerned here with his interest in science and scientific research, of which he was a convincing advocate He played an active part in the development of scientific institutions in Belgium. The protection of flora and fauna, particularly of tropical regions, early attracted his attention, and in 1909, after a visit to the Congo, he put forward a plea for protective measures which culminated with the creation, in 1929, of the Parc National Albert, a nature reserve of nearly 1,400 square miles So recently as 1932, King Albert visited the Kivu Park with Prof V Van Straelen in order to see for himself the effectiveness of the protective measures

KING ALBERT's name will also be associated with the "Fonds national de la recherche scientifique" in Belgium. Speaking at the one hundred and tenth anniversary of the well-known Cockerill iron and steel works at Seraing in the autumn of 1927, the King declared emphatically that pure science is indispensable to industry, and that the nation which neglects science and the savant is marked for decadence The appeal had an immediate effect A great gathering was held at the Palais des Académies, Brussels, which was attended by the King, Ministers of State, and representatives of industry, finance, politics, science and the universities Again King Albert made a powerful plea for science, poor herself but the creator of riches, for security and independence for scientific workers in order that they might devote themselves entirely to their studies, then he announced the creation of the "Fonds national", to which he invited industrial and financial interests to contribute King Albert was well known in Great Britain, and on a recent visit, his enthusiasm for scientific research led him to spend an afternoon examining the treasures of the Royal Institution, after which he enjoyed a 'laboratory' tea with Sir William Bragg and members of the staff, and watched some experiments with liquid air in illustration of the late Sir James Dewar's work.

History Made in Germany

IN another column of this issue of NATURE (see p. 298) is a translation of an official circular, issued to all education authorities in Germany by the Minister of the Interior, on the teaching of prehistory and history, which contains 'directive ideas' to be followed in historical instruction and to serve as a standard in the adoption of textbooks. The directions in the circular deal first with certain 'points of view' which "hitherto have been considered inadequately, if at all", and secondly, give an outline of the manner in which the theory of Nordic racial and cultural supremacy is to be applied in dealing with the course of events from the earliest times to the present day. The study of 'race' and 'culture' are to be made to subserve the German nationalist idea, while the heroic legends will quicken the emotional appeal of leadership in present-day 'national assertion'. From the point of view of prehistoric and historical science, the contents of this document are astonishing It is scarcely necessary to point out that the racial and cultural unities which are to be made the basis of the modern German nationalist State are non-existent in point of fact, but rest on misstatement or misinterpretation. If, however, these 'directive ideas' appear too biased, too frankly propagandist, to call for critical examination from the point of view of ethnology, archæological science, or history, they must none the less be regarded as symptoms of a grave condition of thought The circular suggests that Germany is prepared to abandon all standards of intellectual honesty in pursuit of a political ideal, which, it may be noted, it is hoped to impose on all 'Nordic' peoples

Prof. Harold C. Urey

PROF HAROLD C UREY, of Columbia University, has been awarded the Willard Gibbs medal of the Chicago Section of the American Chemical Society for his discovery of 'heavy water' Prof Urey, at the age of forty-one years, is the youngest man ever to receive this honour He was born in Walkerton, Ind , on April 29, 1893 In 1917 he was graduated from the University of Montana with the degree of bachelor of science in zoology In 1923 he received the Ph D. degree in chemistry from the University of California He received an American-Scandinavian fellowship for research in 1923–24, studying under Prof N Bohr at Copenhagen He was assistant in chemistry at Johns Hopkins University in 1924–29, and has been associate professor of chemistry at Columbia since 1929. The Willard Gibbs medal, founded by William A. Converse in 1911, was named after Josiah Willard Gibbs, professor of mathematical physics at Yale University from 1871 until 1903, who, although not primarily a chemist, did much to advance the science of chemistry It is awarded annually by the Chicago Section of the American Chemical Society to a scientific worker "whose work in either pure or applied science has received worldwide recognition" The award is determined by a national jury of men of science. The first Gibbs medallist was Svante Arrhenius of Sweden.

Constitution of the Stars

THE fourth Rickman Godlee lecture was delivered at University College, London, by Sir Arthur Eddington on February 16. Lord Dawson of Penn presided, and paid a tribute to Rickman Godlee's great pioneer work in the surgery of the brain and to his wide range of interests in scientific work and in affairs. Sir Arthur Eddington took as his subject the "Constitution of the Stars". He reminded the audience that the problem of the constitution of the stars was first set forth in a paper, with a somewhat strange and comprehensive title, published by Lane in 1869. Since then, many attempts have been made to compute the temperatures existing deep inside the huge celestial furnaces. Thus, in the case of the sun, whilst the measured temperature of the photosphere is six thousand degrees, the computed temperature at the centre is twenty million degrees. This central region is now considered to be constituted of swarms of protons and stripped atoms moving at speeds of hundreds of miles per second, of swarms of electrons moving at ten thousand miles per second, and an enormous quantity of X-radiation which is mainly responsible for the permanent shape of the sun. Because of its nature, the energy of this radiation can only leak away slowly, by a stepping-down process.

OWING to excessive ionisation, the average mass per particle in the middle of the sun is only two units, unless a considerable quantity of hydrogen is present. We have to know the average mass per particle in order to calculate the temperature at the centre. Sir Arthur said that he first made a reservation concerning the effect of hydrogen in 1927. It is now possible to measure the mass and the absolute brightness of a star and to say with some degree of certainty how much hydrogen it contains. In 1934, a further reservation is necessary because of the discovery of the neutron, for if neutrons were present to the extent of five per cent in the constitution, the material heat of the sun would be rapidly lost by conduction. However, it is felt that the properties of neutrons are not yet sufficiently established to make predictions, and, in any event, they can probably only exist inside atomic nuclei when near the centre of the sun. Sir Arthur also discussed the significance of recent experiments on artificial disintegration, which suggest a means by which the energy of the sun is replenished, namely, by the absorption of protons in atomic nuclei. This means that the temperature of the centre cannot rise much above ten million degrees so long as appreciable amounts of hydrogen are present.

REFERRING to the "gaseous mass" postulated in Lane's paper, Sir Arthur Eddington pointed our that the sun obeys laws deduced for perfect gases, because of the huge compressibility of the stripped atoms inside the furnace. Densities some thousands of times greater than that of the earth are thus possible, and, indeed, are actually found to exist, for example, in the case of the dark companion of Sirius. Moreover, an application of the Pauli exclusion principle shows that such extremely dense matter must be cold, as is the companion of Sirius. Thus, although we seem farther away than ever from a solution of the problem of the evolution of the universe, Sir Arthur suggested that, since we are now able to formulate problems which were not even suspected ten years ago, we can more adequately measure our progress by the problems we are able to present for solution rather than by those we are able to solve.

Oil from Coal in Great Britain

OIL from coal was the subject of a debate in the House of Commons on February 8, when the British Hydrocarbon Oils Production Bill was read for the second time. The Bill proposes to give a preference of 4*d*.-9*d*. a gallon on oil derived from British coal, peat and shale. The exact amount of the preference will depend on the customs duty payable on imported material, or on the difference between it and any excise duty. The duration of the preference will depend on its amount: at the minimum rate of 4*d*. a gallon it will operate for nine years, or, at 9*d*. a gallon, for four years. The Secretary for Mines (Mr. E. Brown) reported that the Government announcement of policy has already been followed by industrial developments. Imperial Chemical Industries have started the erection of a plant at Billingham for the annual production of 100,000 tons (30,000,000 gallons) of motor spirit by the hydrogenation of coal. A substantial increase is also shown in the amount of benzol obtained last year from gas works and coke ovens, as well as in the quantity of motor spirit from shale oil and low temperature carbonisation processes. More than 10,000 men have been put into employment already in connexion with the Billingham plant, and, in operation, it will absorb 1,280 men, and, in addition, some 1,200 miners for the production of 350,000 tons of coal a year. The actual cost to the Treasury of the production of 100,000 tons of oil under the new preference will, it is estimated, be about £1,000,000.

Economic Issues in Hydrogenation

THE debate on the Bill referred to above brought forward a number of criticisms of the scheme. The opinion was voiced that the enterprise should be State-owned and directed, and also that the developments should be planned so as to assist the more depressed mining areas. It was also pointed out that hydrogenation has been in progress for a number of years in Germany, where very cheap lignite is available. In spite of a similar preference granted in that country, the synthetic petrol manufactured there in 1933 was less than the amount which is to be produced in Great Britain under the new scheme. Both the technical and the economic success of the process were, in fact, questioned. The motor-car industry is also faced with developments in heavy-oil engines of the Diesel type, which may in time displace light-oil engines and lessen the demand for petrol. A strong case was put forward, however, for the founding of this new industry as a means of utilising British coal resources more efficiently, and also for the covering of the requirements of national defence.

Research on Foul Brood Diseases of Bees

BY co-operation between the bee keepers of England and the Agricultural Research Council, financial arrangements have been made to carry out at the Rothamsted Experimental Station, an investigation of foul brood diseases of bees, which have hitherto caused considerable trouble and loss. Dr. H. L. A Tarr has been appointed investigator. Dr. Tarr is a graduate of the University of British Columbia and McGill University, and since 1931 he has been working at bacteriological problems in the Biochemical School at the University of Cambridge Foul brood diseases were investigated in England nearly fifty years ago by Cheshire and Cheyne, and in more recent years by workers in the United States, Canada and on the Continent, but in spite of all that has been done, little is known about the cause of the diseases and still less as to how to avoid or cure them The bee keepers, through the British Bee Keepers Association, have now agreed to raise half the money necessary for the investigations, and the Agricultural Research Council has undertaken to contribute the other half As a result, a sum of £500 a year is now available for the study of foul brood It is hoped that the work will continue for a period of at least three years, starting early in March 1934 under the general direction of Dr C. B Williams, head of the Department of Entomology at Rothamsted, with the co operation of Mr. D M T. Morland, apiarist. Some of the more purely bacteriological side of the work will be carried out at the Lister Institute in London. Rothamsted Experimental Station will be advised on the practical side of the work by a small expert committee of bee keepers Further contributions towards the cost of the investigations will be welcome

National Importance of Scientific Research

REVIEWING the organisation of industrial research in Great Britain and other countries in an article in the *Draughtsman* of December entitled "Research and Industry", Mr G Windred concludes that we are at present by no means in a leading position, due perhaps to the curtailment of research expenditure in almost every direction, consequent upon the reduction of Government expenditure and the unwillingness of commercial organisations to spend capital. Mr. Windred states that industry, as a whole, is not prepared to apply scientific research methods until their possibilities have been clearly demonstrated "Such demonstration can be effected only with the aid of research experience which must involve considerable expenditure, such as other countries have in general been willing to provide". The author reminds us that in the various departments of pure science, Great Britain holds a premier position which must prove of great assistance in the work of applying scientific principles to industrial improvement, and pleads for increased opportunities for industrial research. Assuredly, in this era of world-wide industrial progress, we can no longer afford to suffer the accusation that, however important are our fundamental discoveries in pure science, we yield pride of place to others in their application.

PUBLIC interest in the national importance of scientific research has recently been stimulated in Germany by a series of publications which are intended to awaken all classes to a realisation of the material benefits involved, and to counteract the tendency for too stringent economy in scientific work These publications, which are written in non-technical language, are sponsored by scientific and educational associations of high standing. In the United States there are said to be more than 1,500 well-established research organisations, and the expenditure of American industry in support of these research laboratories has been assessed for the year 1931 at no less than 235 million dollars. The activities of the Mellon Institute of Industrial Research of the University of Pittsburgh are too well known and appreciated in Great Britain to require more than a passing reference As regards Russia, Mr Windred has no doubt that the plans for scientific reconstruction in that country have the strongest scientific arguments in their favour. He devotes considerable attention to the work of the British Science Guild, which was founded in 1905 by Sir Norman Lockyer. The following statement, which the Guild has included in the announcement of its aims, objects and activities, is so manifestly pertinent to the conditions of to-day that it deserves the widest possible publicity . "The most urgent practical need to-day is the promotion of the spirit of unity among all classes through the alliance of Science, Invention and Labour, working as a single force for national development and common welfare Science discovers ; Invention applies ; Industry produces. No nation can occupy a place in the van of modern civilisation unless the three legs of this tripod form strong and secure supports for all its constructive activities".

Recent Advances in Microscopy

MR CONRAD BECK, in his presidential address to the Royal Microscopical Society on January 17, pointed out that the resolution of the microscope had reached at least 100,000 lines to the inch in the middle of last century, and this limit was extended by steady advances to nearly 140,000 by the end of the century, but the limit is now placed at a figure that is less than 1/300,000 in In referring to dark ground illumination, he stated that while it was used with low and moderate powers almost from the time achromatic microscopes were first made, it is only in recent years that the refined apparatus required to use it with high power lenses has been produced. He remarked that this technique does not render differential staining less important and expressed his satisfaction that the Council of the Society has appointed a committee to study the stains and reagents used for microscopic research, and he suggested that, in addition to other matters, consideration should be given to the introduction of differential stains, particularly designed for dark ground illumination. As an example, he cited the anthrax bacillus which, stained with methylene blue, appears blood-red by dark ground, and hence there might be stains which would differentiate structure viewed by this means to a greater extent than can be done with transmitted light.

Dark ground illumination has not only doubled the resolution of the microscope, but also has more than doubled the visibility of small objects The use of quartz lenses corrected for ultra-violet light involves photographing images, but as no direct method of focusing is satisfactory an indirect method has been devised. An object-glass was made suitable for visual observation with approximately the same focal length as the quartz lens and a perfect method of interchanging the two has been worked out. A slow motion fine adjustment that can be moved a definite amount with certainty to compensate for the small predetermined difference in focus, and capable of moving the lens with an accuracy of $\frac{1}{30}\mu$, is the chief factor in the success of the technique In concluding, Mr Beck referred to the high cost of the apparatus necessary and asked whether this type of work should not be carried on in endowed institutions, just as is modern astronomical work.

Boilers for Critical Pressure

A notable paper was read to the Institution of Electrical Engineers on February 15 by F Ohlmuller on the Benson boiler and its development for use in power stations Dr. Mark Benson came to Great Britain some years ago and with the help of the English Electric Co carried out experiments on a 500 h p. steam turbine built for the purpose of working with steam evaporating at the critical pressure (3,200 lb. per sq in) At this pressure the latent heat of water is zero The water being heated to the critical temperature (706° F) turns completely and instantaneously into steam. Unlike ordinary boilers there is no separation of steam from water. In the present design of the boiler, dry steam is produced with certainty in steel tubes. At the outset, many difficulties had to be overcome. The manufacturing rights are now the property of the Siemens-Schuckert Co of Berlin. They have overcome the trouble experienced with the tubes at Rugby. They now manufacture tubular boilers for use both at the critical and at subcritical pressures. Tests showed that the burning out of the tubes was due to the precipitation of salts contained in the feed water on the parts of the tubes where the water changes into steam. This occurs in the zone where evaporation terminates and superheating begins. The remedy is to change the zone of deposit to a region of lower flue-gas temperature

Hitherto the pressure in steam boilers has been regarded as a constant dependent on its construction. The Benson boiler operates with high efficiency not only at the highest possible pressure and at lower pressures, but also with varying pressures, and this seems to open a new field of usefulness. In warships, for example, the fuel consumption must be low at cruising speeds but for temporary maximum speeds, amounting to a multiple of the cruising speed, the quantity of fuel consumed is of minor importance. For cruising purposes, therefore, a relatively low pressure of 300 lb. per sq. in. may be used, and by increasing the pressure, ten times the power output can be obtained. With merchant ships a uniform speed is usually required, but for manœuvring in ports and estuaries a variation of the boiler pressure offers the most economical means of varying the ship's speed. The Benson boiler seems very useful for many purposes. For stationary steam plants with widely variable load (peak load stations) and locomotives, it can be operated at pressures varying with the load. A cheap and simple turbine only is required and an approximately constant thermal efficiency at all loads is obtained. In erecting many generating stations, industrial plants and thermal stations, difficulties often arise owing to the uncertainty about the future load With this new boiler an increase in the output whenever necessary can be obtained simply by raising the pressure of the steam, as the cost of adapting the turbine and piping to the new conditions is small

Negro-Indian Crosses in Mexico

Spanish settlers in Mexico and Central America appear to have taken an interest in the results of racial intermixture from early days Several series of paintings in oils of seventeenth century date are in existence, of which each picture depicts a family of mixed breed, both parents and children, Spanish-Indian, Spanish-Negro and Indian-Negro, the characters being faithfully presented. The number of pictures in each series is usually five or six. One of the best is, or was, in the possession of the Hulse family, the tradition being that it was part of the dower of Dorothy Woodrow, who married the first baronet towards the end of the seventeenth century. The series was supposed to have been captured from the Spanish in a naval engagement; but some at least of the pictures obviously must be of later date. It is interesting to note that the evidence of cross-breeding as shown in physical characters is still to be observed in the descendants of these early admixtures.

A joint Mexican and Italian expedition which is now engaged in observation of the natives of the coast of Guerrero, southern Mexico, reports, according to a communication issued through Science Service, Washington, D.C , that not only do the inhabitants of this area show the traces of their descent from the Negro blood of colonial days in a complexion which is appreciably darker than that of the general run of the Indian population, but also the two communities of Indian and Negro blood hold aloof from one another, and show marked differences in temperament and custom The natives themselves make use of no less than five terms to distinguish the degree to which the hair of the head shows the Negro character. The tight-kinked African hair is called 'cuculuxtle', an Aztec Indian word; hair tightly curled in ringlets, which shows a slight dilution of Negro blood, is 'chino'; the looser waves produced by a greater proportion of Indian blood is 'crespos'; and the 'pelo quebrado', 'broken hair', is Indian hair which is only slightly waved.

Institute of Plant Industry, U.S.S.R.

A list of publications of the Institute of Plant Industry, U.S.S.R. from 1908 until 1931, compiled by Windelbandt (Bibliographical Contributions No. 2, Institute of Plant Industry, Leningrad) supplies a long-felt want amongst applied botanists. Reorganisation and changes of title, which have at various times affected the Institute and its publications, have made it difficult for many to check the completeness of their sets of publications. The Institute of Plant Industry, as it is known to-day, uniting the activities of numerous research institutions and field stations, has evolved from the Bureau of Applied Botany founded in 1894. The serial numbering of the original *Bulletin* is maintained, and this list takes the *Bulletin of Applied Botany, Genetics and Plant Breeding* to the point where it is split up into three series, one of which is subdivided into thirteen sections. The list is published in Russian and in one other language, generally English or German, according to the language in which the summary or translation is issued. While German was used up to 1914, most translations now appear in English An indication is also given in cases where the articles appear only in Russian, and also if the number is out of print. The list, which includes supplements and seed catalogues, has a wide interest. A large amount of work of a fundamental nature is included as well as the ordinary routine crop experimental work The crops include tea, oil- and rubber-bearing plants, etc , in addition to the usual crops found in Europe

Pelotherapy

Peloid, from the Greek πηλος (= mud), was adopted by the International Society of Medical Hydrology at its recent annual meeting in Switzerland as a generic name applicable to any naturally produced medium such as is used in medical practice as a cataplasm for external treatment. Such media are known in the various countries as boue, fango, gyttja, liman, moor, mud, peat, schlamm, etc , these names being used in confusion for both specific media and in a generic sense The new word, with its derivatives *pelology* and *pelotherapy*, will avoid this confusion and allow the local terms to be defined and used in their restricted sense The Society appointed an International Standard Measurements Committee, with Dr. S Judd Lewis as chairman, to investigate the properties of these peloids, and they are now classified into groups as (1) purely mineral , (2) alluvial and marine, characterised by the organic matter being of the thallophyte type, as is the case with those permeated with algal, diatomaceous, bacterial and similar structures: (3) an intermediate group of terrestrial peloids; (4) those of mainly vascular-vegetable origin, such as moors or peats from (*a*) mosses, (*b*) phanerogams, etc , (5) peloids mainly of marine vegetable origin; (6) peloids derived from petroleum deposits; and a detached group, 10, for 'artificial' or 'factitious peloids' The Committee has now to consider the components—saline, mineral (geological), organic (for example, humus), vegetable structures, micro-organisms, etc.; the physical properties—heat conductivity, heat capacity, plasticity, colloidal properties, radioactivity, etc ; and the clinical indications.

First International Congress of Electro-Radio-Biology

WE have received a notice that the International Society of Radio-Biology, having its headquarters in Venice, is preparing to organise the First International Congress of Electro-Radio-Biology, which it is hoped will take place in that city in September next. It may be that there is room for an international society dealing with this subject, but a very considerable part of the programme would appear to come within the purview of the International Congress of Radiology which meets in Zurich in July of this year. It appears from the memorandum issued that a number of representatives from different countries will give lectures and speeches at this proposed Congress, but we regret to say that we do not see the name of a single British representative; but other names, it is stated, will be added in successive communications, so that should the Congress take place, we hope to see some representatives from Great Britain take an appropriate part Those who desire more detailed information are invited to apply to the temporary head office of the International Society of Radio-Biology, addressing their correspondence to . Dr Giocondo Protti, Venice (Italy), Canal Grande—S Gregorio 173

A Map of the British Isles, 1603

IN the University of Göttingen there is apparently the only copy of a map of the British Isles published in 1603 by John Woutneel and engraved by William Kip. It is a large sheet cut into four and came into the possession of the University in 1735 A photostat of the map is now in the British Museum In the *Geographical Journal* of December, Mr. E Lynam gives some account of this map. Woutneel was a Flemish bookseller living in London and Kip was a Dutch engraver who engraved the thirty-four maps in Camden's "Britannia" (1607) England and Wales on Woutneel's map are copied from the second edition (1594) of the Hondius map and show different spellings and more names, some of which are taken from Saxton Scotland is copied from the Ortelius map of 1573 Ireland is based mainly on the 1594 map, but seems to contain some original work Mr. Lynam does not believe that this map was the general map of an atlas that embraced the anonymous county maps of 1602–3, which do not appear to be Kip's work. It is not a good map Mistakes are numerous and there is evidence of hasty copying but it is notable for the marking, not always correct, of battlefields, and its fine engraving. It will be of interest to discover if other copies are in existence.

Biochemical Research in India

THE Society of Biological Chemists, India, now in its third year, publishes annually "Biochemical and Allied Research in India"; the number for 1932 has recently been issued. This publication takes the form of a review of research work published during the year, by Indians and other workers in that country, usually in Indian journals. The subject matter is dealt with under the following headings:

enzymes, agricultural chemistry, food and nutrition of farm animals, dairy chemistry, general microbiology, vegetable physiology, phytopathology, pharmaceutical and medicinal chemistry, nutrition and vitamins, and the chemistry of sanitation with special reference to sewage and to water. The journal is edited for the Society by a committee and the names of the reviewers are appended at the end of each section Upwards of three hundred papers are referred to, indicating the vitality of research into biochemical problems in India. Although many of the results obtained are chiefly applicable to conditions in that country, much of the work is of a wider interest and must be taken into consideration by workers on similar problems in other parts of the world This journal forms a ready means of keeping in touch with biochemical research in India.

Birds of Hawaii

A REPORT that Hui Manu, the bird society of the Honolulu and Sandwich Islands, has decided to undertake a scheme for breeding and distributing many of the vanishing birds of the Hawaiian archipelago, is of interest, for these Pacific islands are perhaps the most isolated of all oceanic groups Rothschild ("Avifauna of Hawaii and nearby Islands", 1893–1900) records 47 species from Hawaii, 34 of which breed, and from the neighbouring islands, Laysan 40, Kawai and Nishan 41, Oahu 28, Molokai 21, Maui 26 and Lanai 18. The introduction of many birds foreign to the islands, and particularly the European house-sparrow (*Passer domesticus*) now one of the commonest birds of the islands, has seriously affected the native avifauna, while Wetmore (*Nat Geog Mag.*, 18, 77; 1925), in a survey of the bird-life of the group, recorded considerable damage from the introduction of rats and rabbits It was in 1909, through the interest of President Roosevelt, that the Hawaiian Bird Reservation was set up under the control of the United States Department of Agriculture. Amongst the fifty odd species recorded in the group, Heilprin states all the passeres and five of the aquatic and wading birds are peculiar

North East Coast Institution of Engineers and Shipbuilders

AT a meeting of the Council of the North East Coast Institution of Engineers and Shipbuilders held on February 12, Mr Summers Hunter, formerly chairman of the North-Eastern Marine Engineering Co., Ltd, presented the warrant of the College of Arms granting armorial bearings to the Institution. Mr Summers Hunter has been connected with the Institution for nearly fifty years as a president, and also an honorary fellow He is also a past president of the Institution and of the Institute of Marine Engineers. The arms of the bearings are an ancient ship with sails set, surmounted by a tower triple-towered between two wheels, symbolical of engineering. The crest is a sun encircled by a chain, representing the harnessing of the forces of Nature for the use of man. The motto is "By Science, Industry and Honour".

Announcements

THE first educational tour of the Institute of Metals will be made to Belgium on April 8–14, when student members will have an opportunity of visiting six large metallurgical establishments and of seeing something of Brussels (including its University) and Bruges. The cost per head will be £6 10s. Students desirous of participating should communicate before March 12 with the Secretary, Mr. G Shaw Scott, 36 Victoria Street, London, S.W 1.

AT the annual general meeting of the Quekett Microscopical Club held on February 13, the following officers were elected for 1934–35 *President*, J Milton Offord; *Vice-Presidents*, C. D Soar, J Ramsbottom, E A Robins and J T Holder, *Hon Treasurer*, C H Bestow; *Hon Secretary*, W S Warton, *Hon. Reporter*, A Morley Jones, *Hon Librarian*, C H. Caffyn, *Hon Curator*, C. J Sidwell, *Hon Editor*, W P Sollis; *New Members of the Committee*, Percy C. Palmer, C Harvey, E J. Stream, A W Sheppard.

WE much regret that the name of the author of the article entitled "Reference Chart for the Apparent Motions of the Sun, Moon and Planets" in NATURE of January 6, p 33, was spelt incorrectly The author's name should have been printed "Dr B. K. Vaidya"

THE encyclopædic "Handbuch der biologischen Arbeitsmethoden" edited by Prof. Abderhalden includes, among its most recent parts, one written by Dr. F. Zacher. This instalment deals with the behaviour and development of insects affecting stored products It can be recommended as an up-to-date work of reference written by a leading European authority on the subject.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—A chief librarian for the County Borough of Southport—The Town Clerk, Town Hall, Southport (Feb 26). A principal assistant (technical) in the Chief Engineer's Department of the London County Council—The Clerk of the Council, The County Hall, Westminster Bridge, London, S E (March 2) A City engineer and surveyor to the City of Bradford – The Town Clerk, Town Clerk's Office, Bradford (March 10) An assistant keeper on the higher technical staff of the Science Division of the Science Museum—The Director, Science Museum, South Kensington, London, S.W 7 (March 10) A vice-principal and head of the Mathematics Department at the Leeds College of Technology—The Director of Education, Education Offices, Leeds (March 10). A mechanical engineer as assistant to the chief engineer of the Dublin Port and Docks Board—The Secretary, Port and Docks Office, Dublin (March 14) Two lecturers to share the teaching of mathematics, physics, biology, chemistry and geography at the Cambridge Training College for Women—The Principal (March 14). A chief engineer at the British Drug Houses, Ltd., Graham Street, London, N.1—The Managing Director.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

International Status and Obligations of Science

IN his Huxley Memorial Lecture, extracts from which were published in NATURE of December 23, Prof A. V. Hill has made detailed statements regarding the treatment of German scientists by the National-Socialist Government. These statements are not in accordance with the truth As a scientist, whose duty it is to discover and proclaim the truth, I venture to place on record the following facts as against the inaccurate assertions of Prof Hill

The National-Socialist Government has introduced no measure which is directed against the freedom of scientific teaching and research, on the contrary, they wish to restore this freedom of research wherever it has been restricted by preceding governments Measures brought in by the National-Socialist Government, which have affected Jewish scientists and scholars, are due only to the attempt to curtail the unjustifiable great influence exercised by the Jews. In Germany there were hospitals and scientific institutes in which the Jews had created a monopoly for themselves and in which they had taken possession of almost all academic posts There were in addition, in all spheres of public life in Germany, Jews who had come into the country after the War from the east This immigration had been tolerated and even encouraged by the Marxist government of Germany Only a very small part of the 600,000 Jews who earn their living in Germany has been affected by the National-Socialist measures No Jewish civil servant was affected who had been in office before August 1, 1914, or had served at the front for Germany or her allies or whose father or son had fallen in the War.

Prof. Hill asserts that something more than a thousand scholars and scientific workers have been dismissed, among them some of the most eminent in Germany In reality not half this number have left their posts, and among these there are many Jewish and slightly fewer non-Jewish scientists who have voluntarily given up their posts Examples are the physicists Einstein, Franck, Born, Schrödinger and in addition Landau, Fränkel (mathematician), Fränkel (gynæcologist), Prausnitz (hygienist), and others. Prof Hill says that there are 100,000 people in concentration camps in Germany and that they are there only because they wished to have freedom of thought and speech The truth is that there are not even 10,000 in the concentration camps and they have been sent there, not because of their desire for freedom of thought and speech, but because they have been guilty of high treason or of actions directed against the community. It must also be said that no women and children are imprisoned in the concentration camps in order to bring pressure to bear upon their husbands and fathers.

It would be a good thing to keep political agitation and scientific research apart This is in the interests of science as well as in the interests of international scientific co-operation But when a scientist does mix politics with science, he should at any rate fulfil the first duty of a scientist, which is conscientiously to ascertain the facts before coming to a conclusion.

J. STARK.

Physikalisch-Technische Reichanstalt,
Berlin-Charlottenburg
Feb 2

WITH Prof. Stark's political Anti-Semitism I need not deal. to an unrepentant Englishman (without any Hebrew ancestry or Marxist allegiance) it appears absurd.

It is a fact, in spite of what he says, that many Jews, or part-Jews, have been dismissed from their posts in universities, although they served in the line in the German armies in the late War There are dozens of such in the lists of the Academic Assistance Council: whether they were "Beamte" or not is a quibble. Nor is there sense or justice in dismissing persons who were not "Beamte" before August 1, 1914.

Doubtless there are many grades of "dismissal", and in a technical sense certainly some of the persons in our lists were not "entlassen". They have found it impossible, nevertheless, to carry on their work in Germany. Men of high standing do not, without cause, beg their colleagues in foreign countries for help. Whether they were "dismissed", or "retired", or "given leave", or merely forbidden to take pupils or to enter libraries or laboratories is another quibble · the result is the same. It is inconsistent with that "freedom of scientific teaching and research" which the German Government apparently is seeking to restore.

As regards "high treason" and concentration camps, in England we do not call liberalism or even socialism by that name. The statement about women and children is a 'red herring'—I never said or suggested anything of the kind.

No doubt in Germany, after this reply, my works in the *Journal of Physiology* and elsewhere will be burned

May I take this opportunity of saying that the Academic Assistance Council (Burlington House, W 1) urgently needs funds—for in spite of all the quibbles, scholars and scientists are still being dismissed

A V HILL.

University College,
Gower Street,
London, W C 1.
Feb 10

Cytochrome and the Supposed Direct Spectroscopic Observation of Oxidase

IT has been shown previously[1] that some of the bands of the absorption spectrum, described by Warburg and his co-workers[2,3], in *Acetobacter* (*Bacterium pasteurianum*) and ascribed by them to the oxidase or oxygen transporting enzyme, do not belong to this enzyme but to cytochrome. It was also shown that similar absorption bands are visible not only in organisms with a very active oxidation, such as *Acetobacter* or *Azotobacter*, but also in organisms having a much lower respiratory activity, such as brewers' yeast, *Bacillus proteus*, *B. coli*, and *B. dysenteriæ*.

The study of micro-organisms reveals certain variations in the structure and properties of cytochrome. While in the majority of cases the absorption spectrum of cytochrome is similar to that found in bakers' yeast (1, Fig. 1) in other cases (2–6, Fig 1) the bands *b* and *c* may be replaced by one band (b_1), or band *a*, usually lying at about 603mμ, may be shifted either towards the short wave end (a_1, 586 mμ or 590 mμ) or towards the long wave end (a_2, 628 mμ or 630 mμ) of the spectrum

In *B. proteus* and *B. coli*, in addition to bands b_1, at 560 mμ and d_1 at 530 mμ, a very faint shading a_1 can be perceived at about 590 mμ and a band a_2 is clearly visible at 628 mμ. (This position having been determined with the reversion spectroscope is more correct than 630 mμ given previously.) On shaking the suspensions of these bacteria with air, the bands b_1 and d_1, are replaced by two very faint and diffuse bands at about 566 mμ and 535 mμ, while the band a_2, as was previously shown in *Azotobacter*[1], is replaced by a narrow band at 645 mμ (9, Fig. 1) which in the absence of oxygen, or on reduction with sodium hydrosulphite, moves back to 628 mμ.

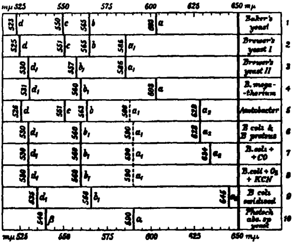

FIG 1 1–9, positions of the absorption bands of cytochrome in cells of different organisms Dotted line marks the faint shadings 10, position of α- and β-bands of the photochemical absorption spectrum in yeast and *Azotobacter* according to Warburg and his co-workers.

The bands at 628 mμ and 645 mμ represent, therefore, the α-bands of the reduced and oxidised component a_2. On shaking the suspensions of these bacteria with air in presence of potassium cyanide (8, Fig. 1) the component b_1 remains in the reduced form, while the band at 645 mμ disappears completely, as was recently shown to be the case in *Azotobacter*[4], or is more probably replaced by a diffuse band in the green, too feeble to be detected in the thick suspension of bacteria. The effect of potassium cyanide on the absorption spectra of these bacteria differs therefore markedly from its effect on *B pasteurianum*. In the latter, according to Warburg and his coworkers, potassium cyanide in presence of oxygen is responsible for the appearance of a band at 639 mμ

When the suspensions of these bacteria (*B. coli*, *B. proteus* and *Azotobacter*) are saturated with carbon monoxide, no change can be noticed in the yellow region of the spectrum (at about 590–593 mμ) where, under similar conditions, a narrow band appears in *B. pasteurianum*[2,3]. The band in the red (a_2), on the other hand, in presence of carbon monoxide is shifted from 628 mμ to 634 mμ (7, Fig 1) The carbon monoxide compound of the component a_2 has therefore its α-band (634 mμ) at least 400 A. nearer the red end of the spectrum than the α-band of the photochemical absorption spectrum (590 mμ) obtained with yeast or with *B. pasteurianum* and ascribed to the oxygen transporting enzyme

That the band in the red (a_2) does not belong to this enzyme is shown by its peculiar distribution in cells of various organisms. While this band is visible in a 4 mm. layer of a 50 per cent suspension of *B. coli*, it is invisible in a cake 8 mm. thick of bakers' yeast, the respiratory activity of which is, if anything, higher than that of *B. coli*. Moreover, in a mixture of a suspension of *B coli* with that of bakers' yeast, both bands *a* (of yeast) and a_2 (of *B coli*) can be seen simultaneously, which shows that the band a_2, if present, would not be masked by the band *a*. It should be noted, however, that the bands a_1 (586 mμ or 590 mμ) and a_2 (628 mμ or 630 mμ) have been seen so far only in cells where the typical band *a* (603 mμ) was missing

The components of cytochrome, as was shown previously, are hæmochromogen compounds which differ from artificial compounds like pyridine-hæmochromogen in that they do not usually react directly with molecular oxygen or carbon monoxide. These differences are, however, not constant. In fact, the components of cytochrome, being more or less labile, are easily modified under the influence of various factors and acquire the properties of artificial hæmochromogens in reacting with molecular oxygen and carbon monoxide

Of all the components of cytochrome, the component *a* is perhaps the most labile It is not surprising, therefore, that some of its derivatives such as a_1 in *B pasteurianum* or a_2 in *B coli*, *B. proteus* and *Azotobacter*, exhibit the above mentioned properties of the artificial hæmochromogen compounds

It may be stated in conclusion that all the absorption bands of hæmatin compounds seen by the direct spectroscopic examination of cells of different organisms belong either to free hæmatin or to the different components of cytochrome, and that no band seen so far can be ascribed to the oxidase or the oxygen transporting enzyme

D KEILIN.

Molteno Institute,
University of Cambridge
Jan 3

[1] Keilin, D, NATURE, 132, 783, Nov 18, 1933

[2] Warburg, O and Negelein, E, *Bioch. Z*, 262, 237, 1933

[3] Warburg, O, Negelein, E and Haas, E, *ibid*, 266, 1, 1933

[4] Negelein, E and Gerischer, W, *Naturwiss*, 21, 884, 1933

Chemical Separation of the Isotopes of Hydrogen

IN their note on this subject[1] Messrs A. and L Farkas have reported the following values for the ratio, α, of the specific rates (H^1 H^2) at which the isotopes are discharged when the metals indicated undergo solution in water · Na, 1 2; Ca, 1 5, Al, 2; Zn, 4 Excepting the statement that sulphuric acid (0 1 *N*) was present during the dissolution of zinc, no indication is given concerning the conditions under which these experiments were performed

Similar experiments have been in progress here, which will be fully described in a paper shortly to be submitted to the Chemical Society, and the purpose of this note is merely to suggest that the figures recorded by Messrs. A and L Farkas are not to be regarded as characteristic constants of the metals. It would seem from a comparison of their results with ours that the value of α for any given metal must depend in some unknown way on the experimental conditions. For example, instead of 1·2 for sodium, we find 2·9, and this figure appears insensitive to the variations of conditions we have tried (2·8, 2·8, 3·0, 2·9 for media ranging from strongly alkaline to strongly acidic). Our ratios for calcium, 1·3–1·6, and aluminium, 4·0–4·9, seem to show a more definite dependence on conditions, the higher value in each case relating to reaction in an alkaline medium. The case of zinc requires special comment because pure zinc is scarcely soluble in dilute sulphuric acid, and, when impure zinc dissolves, the hydrogen is probably liberated at least partly at the impurities. The most nearly pure zinc we could get to dissolve, containing only a minute trace of carbon, gave the value 5·6, but commercial zinc gave a higher value, 6·8, and zinc-copper couples, prepared from pure (insoluble) zinc and varying quantities of deposited copper, yielded values ranging to 8·0. It seems possible that the use of metallic couples may prove a useful auxiliary method of concentrating the heavier isotope of hydrogen.

Our isotopic analyses have in all cases been carried out by determinations of the density of water, and in this connexion we would acknowledge the receipt of valuable help from Mr. J N E Day. We should mention that our experiments include the study of a number of other metals and also of some compounds which, on reaction with water, give volatile hydrides.

E D Hughes.
C K Ingold
C L Wilson.

University College,
London, W C 1.
Feb 13.

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[1] Nature, 133, 139, Jan. 27, 1934

Electrolytic Concentration of the Heavy Hydrogen Isotope

Messrs R P Bell and J. H Wolfendon[1] have recently given their experience in concentrating the hydrogen isotope, namely, that nickel, platinum and copper are about equally efficient as cathodes, and in general the efficiency is surprisingly insensitive to the conditions of electrolysis. Broadly speaking, this is also the conclusion we have reached in a study of the electrolytic separation. There are, however, real differences between different metallic cathodes.

It is a convenience to have a name for the quantity α defined by $d \log H = \alpha\, d \log D$, and we propose the term "electrolytic separation coefficient" (this α is the inverse of the one used by Bell and Wolfenden).

The electrolytic separation coefficients of the metals which we have examined all lie between 7·9 and 2·8, the series in descending order being

Smooth Pt, Pb, Fe, Cu, Ag, Ni, W, Pt black, Ga liquid, Hg.

The coefficient is slightly lower in acid than in alkaline solution. In agreement with Bell and Wolfenden, moderate changes in current density do not make much difference. The position of lead relative to platinum and to mercury is remarkable.

With regard to the application of the over-voltage theory of Gurney, we should like to refer to one point. The theory in its original form implied that the atoms of H (or D) formed by neutralisation of the H_3O^+ (or H_2DO^+) ions are at a very high energy level, namely, the energy of free atoms further increased by the large positive potential energy possessed by the group H_3O at the moment of neutralisation. This involves a very high activation energy, and calculation shows that even if the whole of the applied over-voltage is drawn upon to reduce the activation required, no reasonable amount of current would pass from the solution to the cathode. It must, therefore, be supposed that the activation energy (known to be of the order of 10,000 calories from Bowden's measurements) is not so high as corresponds to the production of free atoms, because of the forces acting between hydrogen atoms and the metal atoms of the cathode surface. These forces modify both the potential energy curves $H^+—H_2O$ and $H—H_2O$, and since the isotopic separation depends on the steepness of these curves, different metals would give different electrolytic separation coefficients. But it seems to us that serious difficulties lie in the way of accepting the over-voltage mechanism proposed by Gurney, which we discuss in a forthcoming article.

B Topley
H. Eyring

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Princeton University,
Princeton, N J
Jan 21

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[1] Nature, 133, 25, Jan. 6, 1934

Nature of Antibodies

It was found by Breinl and Haurowitz[1] that when proteins of an agglutinating serum had been coupled with diazotised atoxyl (*p*-amino-benzene-arsinic acid), the agglutinating power of the serum was not wholly lost. In this process, the proteins are themselves converted into azo-dyes, but the products are not strongly coloured. If, however, benzidine is tetrazotised, and coupled to *R* salt and to the serum proteins, according to the method of Heidelberger, Kendall and Soo Hoo[2], a deep red compound is formed, and the agglutinin again is not wholly destroyed.

If the agglutinins of the serum are proteins, this coloured product should be adsorbed specifically by homologous bacteria. Actually the protein dyes thus formed are readily adsorbed non-specifically. Nevertheless, if weak solutions are used, a striking quantitative difference can be shown between the degree of adsorption by homologous and heterologous bacteria. For example, two tubes (*A* and *B*) were put up. *A* contained a suspension of typhoid bacilli, eight minimal agglutinating doses of typhoid-agglutinin-dye (prepared from the euglobulin of typhoid agglutinating serum) and untreated cholera agglutinating serum. *B* contained a suspension of cholera vibrio in place of typhoid bacilli, the other constituents being the same as in *A*. After agglutination was complete, the agglutinated bacteria deposited in *A* were pink, while those in *B* were colourless. In the converse experiment, using cholera-agglutinin-dye, the cholera vibrios were coloured, the typhoid bacilli uncoloured.

This specific adsorption of the dye from the homologous coloured agglutinin is compatible with the theory that the agglutinins are proteins, but still leaves room for the alternatives: (1) that the agglutinin is attached to protein and not removed when the protein is coupled to the diazo compound, and (2) that the agglutinin is a non-protein aromatic substance which will form an azo-dye.

Supposing that the dye taken up specifically by the bacteria is protein-dye, the amount can be estimated colorimetrically. In example *A*, 1 ml of standard agglutinable suspension took up 2×10^{-6} gm; of the eight minimal agglutinating doses added, less than one dose was left in the supernatant fluid The minimal agglutinating amount for 1 ml of suspension is therefore about 2×10^{-7} gm, an amount less than that required to form a continuous layer on the surface of the bacteria. If this estimate is correct, it is not surprising that preparations of agglutinin should have been prepared in which protein could not be detected

JOHN MARRACK

Hale Clinical Laboratory,
London Hospital
Jan 18

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[1] Breinl, F and Haurowitz, F, *Z Immun Forsch*, 77, 176, 1932

[2] Heidelberger, M, Kendall, F E and Soo Hoo, C M, *J Exp Med*, 58, 137, 1933

Progestin in Placental Extract

SEVERAL facts have led to the supposition that the corpus luteum hormone, called progestin by Allen and Corner, should be present in the placenta; for example, the frequently observed continuance of pregnancy in women after removal of the two ovaries and the increased threshold for the action of œstrin in pregnant animals, even after castration (Courrier)

Collaborating with Dr. A. Luchs, two of us (P. d F and M. T) have tried in vain to extract progestin from the placenta and have published negative results[1] We had, however, obtained slight indications of activity of such preparations and therefore considered that the search for this hormone in the placenta should be continued. W. M Allen and R. K. Meyer[2] have recently described a method for the quantitative separation of progestin from œstrin and emphasised the importance of their method for the isolation of progestin from sources which are very rich in œstrin.

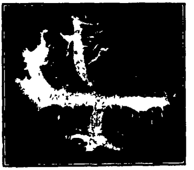

FIG 1 Proliferation of rabbit uterus after treatment with placental extract

Using their method, we have now demonstrated the presence of progestin in two lots of placenta. The first batch was extracted from full term human placenta and tested on an infantile rabbit (activated with œstrin after Clauberg's method) and gave distinct proliferation in a dose corresponding to 600 gm. of fresh tissue (Fig 1). The second batch was prepared from placenta of pregnant cows and tested on an adult castrated rabbit (6,800 gm) and on an infantile activated rabbit (500 gm) Both animals showed distinct proliferation of the endometrium in doses of 1,500 gm and 500 gm. respectively of fresh tissue The output of hormone is still rather low and our investigation is now being extended to a quantitative study of human and animal placenta obtained during pregnancy for other reasons than abortion.

A A ADLER
P DE FREMERY
M TAUSK.

Organon Laboratories,
Oss, Holland
Dec 29

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[1] *Pflügers Arch*, 231, 341, 1932

[2] *Amer J Physiol*, 106, 65, 1933

Fine Structure of the *Kα* Line of Beryllium

THE *Kα* line of beryllium, occurring at the very long wave-length of 115 7 A, was measured by Söderman[1], who found it to consist of a broad band 10 A. wide In view of the recently discovered fine structure of the carbon *Kα* line, I have re-investigated the beryllium soft X-ray spectrum, and, as the spectrogram (Fig 1) shows, have found it to consist of two diffuse components That at the longer wave-length is the stronger The separation is 5 3 A or 4 8 electron-volts The measurement of the long-wave component is, however, difficult, as it coincides with the fifth order of oxygen *Kα* A comparison of the width of the component with that of the fourth order of oxygen *Kα* shows that it is too wide to be due to the oxygen line

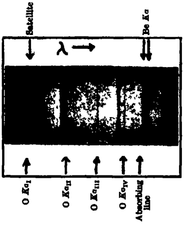

FIG 1

There are two possible explanations of the duplicity of Be *Kα* The first is suggested by the carbon *Kα* structure[2]. The carbon line consists of two (or possibly more) components The stronger of these is attributed to the C $K\alpha_{1,2}$ line and the weaker, short-wave component is probably the ordinary satellite $K\alpha_3$. A simple calculation of the expected separation agrees with the observed value. A similar calculation for beryllium also is in rough agreement with the separation given above The second possible explanation arises out of the fact that the surface of the beryllium is heavily oxidised in my experiments, and it is possible that, whilst one of the components obtained is due to oxidised beryllium, the other is due to the pure metal This possibility is now being investigated

Two other points of interest are observable in the spectrogram First, a faint absorption line appears at the short-wave edge of beryllium $K\alpha$ This absorption sets in at about 111 1 A Secondly, there is quite a strong satellite observable on the long-wave side of O $K\alpha$ at about 24 6 A More precise determinations of these wave-lengths will be published later.

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University College,
London, W C 1.

F. C CHALKLIN

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[1] *Phil Mag*., 10, 600, 1930 See also Faust, *Phys Rev*, 36, 161, 1930 Prins, *Z Phys*, 69, 618, 1931 O'Bryan and Skinner, *Phys Rev*, 44, 602, 1933

[2] See Morand and Hautot, *Comptes Rendus*, 195, 1070, 1932, 197, 521, 1933 Prins, *Z Phys*, 81, 507, 1933 F C and L P Chalklin, *Phil Mag* (in the press)

Dynamics and Mechanism of Aliphatic Substitution

SLATOR[1] observed that alkyl halides and symmetrical ethylene di-halides react bimolecularly with sodium thiosulphate in water, but that the velocity of reaction with iodochlorethane and bromochlorethane was independent of the concentration of thiosulphate The phenomenon under discussion is the transition in kinetic order of a reaction due to a very slight modification in the structure of one of the reactants The problem has been discussed by E D. Hughes and Ingold[2], who reveal varied and more reliable instances of the same phenomenon For example, β-phenylethyltrimethylammonium hydroxide decomposes bimolecularly, whereas halides of the corresponding *p*-nitro derivative decompose unimolecularly

The velocity of hydrolysis of both ethyl chloride and tertiary butyl chloride depends on their concentration, but only in the former case is it influenced by the concentration of alkali The elimination of methyl alcohol and tertiary butyl alcohol from substituted sulphonium hydroxides are processes of the second and first order respectively (E D Hughes and Ingold[3]) According to the theory of Ingold, relating to reactions of type *B*, high cationic stability of the rejectable group and low nucleophilic activity of the reagent-anion tend to favour a unimolecular mechanism, which in turn admittedly implies a relatively long life to the activated organic ion

The question may now be raised whether the kinetic distinction observed between two similar but specific chemical reactions under ordinary conditions would persist at totally different concentrations In principle it is possible for the order of reactions of B_1 and B_2 respectively to become reversed below and above a critical concentration (*c*) of the reagent anion; *c* (in gram-molecules per litre) would be related to the *average* life-time (*t*) of the activated organic reactant (in seconds) by the equation

$$c = \frac{A}{t}\sqrt{\frac{\mu}{T}}$$

μ is the reduced mass of the molecules concerned; and *A*, which is a function of the molecular diameters, is approximately 11. From Slator's data, *t* for iodochlorethane becomes about 5×10^{-10} second. The Lindemann mechanism thus leads to plausible results when applied to reactions in solution; but it is noteworthy that change in kinetic order due to variations in the concentration, although sought[4], has not yet been found. This fact, and the demarcation between mechanisms B_1 and B_2 may have a common origin in the limited range of dilution conventionally employed.

There is no incompatibility between the two hypotheses. On the other hand, Lindemann's theory, accepted as the explanation of a well-known effect discovered by Hinshelwood in gaseous reactions, is in a sense complementary to Ingold's theory, which derives its support from the successful prediction of the course of organic elimination reactions.

E. A. MOELWYN-HUGHES.

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Frankfurt-am-Main,
Germany.
Jan 6

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[1] *Trans Chem Soc*, 85, 1286, 1904

[2] NATURE, 132, 933, Dec 16, 1933

[3] *Trans Chem Soc*, 1571, 1933

[4] Stewart and Bradley, *J Amer Chem Soc*, 54, 4183, 1932

Atmospheric Pressure and the Ionisation of the Kennelly-Heaviside Layer

EVIDENCE of a connexion between meteorological conditions in the troposphere, and the behaviour of radio waves reflected from the Kennelly-Heaviside layer has been noted by Colwell[1] in America and by Ranzi[2] in Italy. Again, Stagg[3] has discovered a relation between the diurnal variation of barometric pressure at Aberdeen and the general state of magnetic conditions over the earth There appears little doubt that some relation exists between conditions in the troposphere and the ionosphere

Evidence which appears to bear on the fundamental nature of the relationship has been obtained as a result of two series of experiments carried out in Melbourne and Sydney during 1931 and 1932

In the first series, carried out at the University of Melbourne with the collaboration of Mr R O. Cherry, during November–December 1931, and March–April 1932, the average night intensity of the sky wave from the transmitter 3 AR (610 kc /sec.) was measured at a distance of 90 km From the second series, carried out between Melbourne and Sydney on a frequency of 1415 kc /sec during October 1932, it was possible to find directly the maximum ionisation density in the *E* layer from observations of the rays of known angle which penetrated that layer.

From both series a very close direct correlation is evident between the average night-time ionisation density in the *E* layer and the barometric pressure at ground-level measured at a time ranging from 12 to 36 hours after the ionisation observation. For example, if on any night the average ionisation density is greater than that on the preceding night, then the barometer invariably rises within the time interval mentioned. In most cases the time lag is near to twelve hours, the greater lag being associated with slower moving disturbances

The results obtained in the first series of experiments are in complete accord with those of Colwell, though the explanation offered differs considerably from his Thus, Colwell considers that the "E layer is concentrated in the regions of low pressure"[4], resulting in a stronger post-sunset signal. On general theoretical grounds it is much more probable that a stronger night signal on the frequency of KDKA (980 kc./sec), upon which station Colwell's measurements were made, would result from a *decreased* intensity of ionisation in the absorbing portion of the

E layer. Such a deduction is even more probable for the frequency at which the first series of measurements described above was made, there being small possibility of electron limitation being operative so early in the night.

That this view is substantially correct appears to be shown by the remarkably close correlation found in the second series of experiments, which gave the ionisation density directly.

The relation of the results described above to those of Ranzi, which are principally concerned with the occurrence of abnormal night time increases in ionisation, is not so obvious. It seems clear, however, that in seeking an explanation of abnormal night ionisation, the possibility of horizontal movements of the ionosphere must not be overlooked. The phenomena described above strongly suggest the presence of winds at these high levels of the stratosphere.

This work is being carried out under the auspices of the Australian Radio Research Board, to which I am indebted for permission to publish this advance report.

D F. MARTYN.

University of Sydney.
Dec 20.

[1] NATURE, 130, 627, Oct 22, 1932.
[2] NATURE, 130, 368, Sept 3, 1932
[3] NATURE, 127, 402, March 14, 1931.
[4] *Phys Rev*, 43, 774, 1933

Small Sand Craters of Seismic Origin

THE small sand craters of seismic origin, described by Dr. Sheppard in NATURE of December 30 (p 1006), as examples of unusual structures, are common results of severe earthquakes in alluvial regions. The formation of such vents and their related fissures was first explained by R. Mallet and T Oldham in the case of the Cachar earthquake of January 10, 1869[1], and their theory was adopted later by R D. Oldham in his description of the numerous and widely spread occurrences caused by the Great Indian earthquake of June 12, 1897[2]. Briefly, this theory postulates a certain amount of vertical movement from below, resulting in the transmission of the wave motion through layers of loose, oozy sand into the overlying, impervious and harder layers of the surface alluvium. The inertia of the latter is believed to cause a compression of the watery sub-stratum and the expulsion of part of its contents through simultaneously formed cracks above, usually as a geyser-like flow. The spurting which reliable eye-witnesses state takes place on these occasions, the return of the water when quiescence is attained and the formation of the craters with their scored sides, are all accounted for satisfactorily by this theory.

The epicentral tract beneath which the Pegu earthquake of May 5, 1930, originated, happened to form part of a vast alluvial plain in Lower Burma, and sand vents, craters and sloughs were produced over wide expanses of country as a result[3] Similarly, after the Pyu earthquakes of December 3 and 4, 1930, in Upper Burma, many examples were noted in suitable places, for their formation demands a bed of watery sand, overlain by a thick deposit of clay[4]. In no case, so far as they were examined either by my colleagues or myself, was any evidence found to lead to a modification of the older theory, still less to adopt the belief that they originated in a subsidence of the land, followed by a restoration to its original level, as stated by Sheppard. Insufficient attention has been paid in the past to the action of gas which may be so liberated from water-bearing strata charged with decomposing organic matter in such situations, but this would in any case only intensify the known, mechanical, surface effects of the disturbances.

The suggestion that the sandstone dykes of the Tertiary formations of south-western Ecuador may have been injected during earthquakes, recalls Kendall's identical explanation of the sandstone dykes and "fossil sand blows" of various parts of the British Coal Measures[5].

J COGGIN BROWN.
(late Superintendent,
Burma Party, Geological Survey of India).

"Dunelm", Broxbourne,
Herts
Jan. 19.

[1] R Mallet and T Oldham, *Quar J Geol Soc*, 28, 255–270, 1872 T Oldham, *Mem Geol Surv Ind*, 19, 46–60, 1882
[2] R D Oldham, *ibid*, 29, 85–111, 1899
[3] J Coggin Brown, P Leicester and H L. Chhibber, *Rec Geol. Surv Ind*, 65, 253–255, 1931
[4] J Coggin Brown and P Leicester, *Mem Geol Surv Ind*, 62, 1933
[5] P F Kendal, *Proc Geol Soc*, Jan 17, 1919

The Infinite and Eternal Energy

I SHALL be obliged if any reader of NATURE can give me the reference for Herbert Spencer's statement that:

"Amid the mysteries that become more mysterious the more we examine them, we find the one certainty that we are in the presence of an infinite and eternal energy from which all things proceed "

I quote from memory of reading this statement some forty years ago I think it was in the form of a letter on the completion of the "Synthetic Philosophy" I have failed to trace it at the British Museum or in Herbert Spencer's works, and the Herbert Spencer Trustees have been unable to find the reference for me. Prof. Wilhelm Ostwald had not heard of it, and he asked me for the reference; but I was unable to give it to him.

It was widely quoted and commented upon in the Press at the time it was published. Consequently, it is strange that there should be any difficulty in finding the reference

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Monte Carlo.
Jan 17.

Tidal Bores

IN NATURE of February 3, p. 180, reference is made to a suggestion by Dr. Vaughan Cornish that a co-operative study of the Trent Bore should be undertaken by a group of students, equipped with tide-gauges, etc.

The late Mr. Champion devoted much time to observations in the Trent, using a special tide-gauge, at a large number of places. At his death we undertook to examine and collate all his material, which was presented to us by his sister. This work is nearly completed, and the results will shortly be published. The characteristic shape of the bore in detail, size, rates of travel, etc., have been deduced for a number of stations.

A. T. DOODSON.

Liverpool Observatory and Tidal Institute,
The Observatory,
Birkenhead.
Feb. 2.

Research Items

Nudity in English Folk-Dancing. A photograph of a carved wooden panel, about 14 in. long, formerly in Lancaster Castle, representing figures apparently engaged in a morris dance, is published in the *Journal of the English Folk Dance and Song Society*, vol. 1, pt. 2, by Miss A. G. Gilchrist. The panel is of uncertain date, but is probably contemporary with Henry VII. There are seven figures represented, of which one wearing a cloak and feathered cap carries pipe and tabor, while another, wearing a high cap and distended skirt and bearing a ladle for contributions, is evidently the 'Maid Marian'. The fool wears cap and bells and carries a bauble or bladder The third figure in the processional is either a nude woman or a boy with artificial female characteristics personating a woman. Sir Edmund Chambers, to whom the photograph has been submitted, suggests a connexion with whatever it may be that lies at the bottom of the Lady Godiva legend and procession. There is evidence for the appearance of nude figures in English dances in the Puritan denunciation of "light, lewde and lascivious dancing" in which the "greatest abuse" of all was "dancing naked in nets", the morris dancers, it was said, coming to dance about church during divine service. It is to be noted that nude figures on misericords, dating from the fourteenth to early sixteenth centuries at Beverley St. Mary, Worcester, Norwich, and elsewhere, wear nets while riding on goats, stags or geese It has been suggested that these nets may have served the purpose of 'fleshings'. The subjects of medieval misericords seem frequently to have been derived by the artist from what he had seen in plays and pageants.

Growth Phases of the Organism of Cattle Pleuropneumonia. The micro-organism of this disease in some of its stages of growth is just on the limit of visibility and is filterable at times through a Berkefeld V filter. Bordet noted that in serum-broth cultures spirillar and filamentous forms develop together with small globular and ring forms. Other authors have suggested that some of these appearances may be artefacts, and various guesses have been made as to the position of the organism, which has been given such generic names as *Asterococcus*, *Micromyces*, *Mycoplasma* and *Asteromyces*. J C G. Ledingham has now studied the problem, and has obtained much information by the use of impression preparations of growth on solid media (*J. Path and Bact*, 37, No 3, 393; 1933) According to him, in the initial stage of growth, numerous deeply staining chromatic corpuscles are seen with ramifying filaments of varying length and containing in their substance small chromatic bodies. Detached pieces of filaments form the vibrionic forms of Bordet. The threads form complicated masses of filaments having much resemblance to actinomycotic colonies. Terminal and endomycelial chromatic nodes in the mycelial filaments swell up into large oval structures, and in the fully developed colony become surrounded with a thick sheath amidst the tangled mycelial threads. Ledingham considers that the organism, as well as that of 'agalactia' which was also studied, must be placed in the family *Actinomycetaceæ*. Filterability through filter candles, he suggests, may be due to an unusual plasticity of the protoplasmic structure.

Plum Rust Fungus on Apricot and Peach. The disease of the plum caused by a rust fungus, *Puccinia pruni-spinosa*, has been known to occur in English gardens for many years. A recent paper by Prof. E S. Salmon and Mr. W. M. Ware (*Gardeners' Chronicle*, Dec. 30, 1933, pp. 490–492) reports that the disease is now attacking apricots and peaches in several districts. The new hosts do not appear to be attacked very severely, and the damage caused is very slight in comparison with the heavy losses of American and New Zealand growers. Descriptions of the fungus are given in the paper referred to, and the interesting suggestion is made that the physiological variation described by Jacky as "form 2" has been introduced to Great Britain from the Continent. *Anemone coronaria*, the St. Brigid anemone, is the winter host of the fungus

Stocks for Cherries and Pears. The fundamental work of the staff of the East Malling Research Station on the standardisation of apple stocks is now being extended to the cherry and pear crops. In the *Journal of Pomology and Horticultural Science*, 2, No. 4, December 1933, two papers are published—"Stocks for Morello Cherries" by Mr. N H. Grubb (pp 276–304), and " 'Free' or Seedling Rootstocks in use for Pears; their Description, Selection, Vegetative Propagation and Preliminary Testing" by Mr. R. G. Hatton (pp 305–334) Three main types of cherry stocks were tried—sweet cherry, Mahaleb and acid cherry—and each type was budded or grafted with scions of Morello. Sweet cherry carried a scion growth of moderate vigour, but selected stocks showed considerable differences. Mahaleb was considerably larger than sweet cherry in the early stages, but later became weaker and more spreading in habit Acid cherry stocks were found to be distinctly dwarfing. Mr. Hatton has classified the free pear rootstocks of Europe, obtaining four main botanical groups (*A*, *B*, *C* and *D*) Some very striking differences in vigour of vegetative clones have been found, and tested under field conditions. The botanical groups all varied considerably, and it is interesting to note that the extremes of vigour were exhibited by members of type *C*. The stock numbered *C*7 produced a total wood-growth of 124 metres, whilst *C*4 only gave 58 metres.

Kerguelen Archipelago. Sir Douglas Mawson contributes to the *Geographical Journal* of January a paper on Kerguelen which embodies the results of his observations during the *Discovery* visit in the summer of 1929–30. The Kerguelen Archipelago, Heard and Macdonald Islands are considered to be subaerial features of a vast submarine rise on the floor of the Southern Ocean. This rise, which was traced by the *Discovery* into a high southern latitude, was formerly supposed to represent the remains of a submerged continental land mass, but Sir Douglas Mawson believes that the petrological evidence points rather to the Kerguelen area being an igneous blister on a deep ocean floor. It may, however, have been of considerably greater extent during the low-level stage of the sea in the peak period of Pleistocene glaciation. Another point of interest is the evidence that the present land topography owes most of its features to the work of ice. Sheet ice has done much of the work while deeply-cut glacial grooves are superimposed on the earlier more general erosion. It is clear that in places, particularly on the west, shelf ice did much to protect the coast from marine erosion. The paper includes a revised map of south-east Kerguelen.

Primary Standard of Light. In an article published in *World Power* of August 1933, Dr. J. W. T. Walsh gave a history of the attempts that have been made to establish a primary standard of light leading up to the work of Ives on the black-body standard. As a direct consequence of this work, the International Commission on Illumination recommended that the brightness of a black body under precisely defined conditions should be adopted as the primary standard of light. Following on these lines, the United States Bureau of Standards developed a form of black body standard which is regarded as very satisfactory. It consists of a small tube of refractory material held at the freezing point of platinum by immersion in a bath of the solidifying metal. The tube is made of thoria and the lower end is filled with powdered thoria. The apparatus is placed in an induction furnace operated by current at a million frequency. The brightness of the hole at the top of the tube is then measured photometrically. In a second article published in the January number of *World Power*, Dr. Walsh gives the results obtained with this apparatus at the national laboratories of France, Great Britain and the United States. These results are: France 58·84 international candles per square centimetre, Great Britain 59·10 and the United States 58·84. This shows that the standard developed at the Bureau of Standards represents a primary standard of light which is reproducible from specification to the precision of about a quarter of one per cent. This is a great advance on any previous proposal. The adoption of this standard will in no way affect the value of the international candle. Its only function is to ensure that there is no drift in its value.

Heats of Dilution. A study of the heats of dilution of aqueous solutions of zinc, cadmium and copper sulphates at 25° (Lange, Monheim and Robinson, *J. Amer. Chem. Soc.*, December 1933) has given results of interest in the theory of strong electrolytes. Within the limits of error, the measured (intermediate) heats of dilution were proportional to the square root of the molality below 0·001 molal. Although this is in agreement with the limiting Debye-Hückel law, the value of the factor of proportionality was not in agreement. The extension of the theory by Gronwall, La Mer and Sandved requires that the heats of dilution should fuse into the limiting law straight lines at very low concentrations. It was found, however, that the individuality of slope persists to the lowest measured concentration, 0·00005 molal, although this behaviour is not disclosed by other methods of measurement, such as electromotive forces and freezing points, a result which the authors suggest is partly due to the lower accuracy of such types of measurement. The values for the heats of dilution are also not in agreement with those found by the electrochemical method, although there is no theoretical ground for expecting the two methods to yield different results. The values for the *a* parameter (correction for ionic radius) in the extended theory are found to be different for zinc and cadmium sulphates, although the electrical method had given practically the same values, and the values of the initial slopes for these 2-2-valent salts were in poor agreement with the value required by the limiting law.

Cracking of Cement. A report issued by the Department of Scientific and Industrial Research (Building Research Tech. Paper No. 15, "Temperature Rise in Hydrating Concrete". London: H.M. Stationery Office, *1s 3d.* net) deals with the rise in temperature in concrete in the process of setting and hardening caused by the chemical reactions between water and cement. In large masses of concrete the rises in temperature may be considerable, and this may not only affect the properties of the material itself but also may influence the distribution and intensity of stresses throughout the mass. The fundamental cause of some of the serious cracking that has occurred in large masses of concrete, is the expansion due to the heat evolved during the hydration process followed by contraction during the subsequent cooling. Rapid-hardening cements attain a high strength during the period when the temperature is highest. During subsequent cooling the concrete may become subjected to internal strain, and this possibility has caused considerable concern among engineers. The report contains particulars of observations of temperature rises made on some fifty important concrete structures in various parts of the world. They show generally that with modern cements there is a tendency to attain higher maximum temperatures, and to attain these temperatures in a much shorter time, than was the case with cements formerly used. The report describes the laboratory methods developed at the Building Research Station for measuring the rise in temperature of a particular concrete under conditions simulating those of practice.

Design of Beam Arrays. One advantage of short-wave transmission in radio communication is that it is possible to concentrate the radiation to a certain extent in one direction, thus forming a beam of waves. In his classical experiments, Hertz showed that by using a parabolic reflector and placing the transmitter along the focal line, much more powerful effects were produced in a receiver placed on the focal line of a similar reflector when the reflectors faced one another. Hence these waves can be reflected by conductors. A series of vertical aerials with their bases on a parabola (called a beam array) will act like Hertz's reflector. In practice, great care is taken to ensure that the axis of the beam lies in a great circle path joining the transmitting and receiving stations, but hitherto little attention has been paid to the correct angle of elevation of the beam. In a paper read to the Institution of Electrical Engineers on January 3 by T. Walmsley, the results of an investigation into the factors controlling the economic design of beam arrays are given and definite conclusions are obtained. The author states that before the design of an array system is undertaken, tests should be made over several months to find the best angle of propagation in the vertical plane. If, as in the case of the Berlin-Rugby circuit, this varies appreciably with the season of the year, an array capable of having its angle of projection varied should be built. In the case of the Rugby-New York circuit, the best angle of projection—about 79° to the vertical—varies very little during the year. As the wavelength increases the cost of array systems for a given efficiency rapidly increases. In this case also the cost increases as the angle to the vertical at which the radio energy is required to be projected or received increases.

The Teaching of History and Prehistory in Germany

THE German Minister of the Interior, Dr. Frick, has issued a circular (under official reference number III 3120/22 6)[*] containing "guiding ideas" (*Leitgedanken*) for historical instruction in all German schools, and has transmitted them to all educational authorities in Germany. These "directive principles" (*Richtlinien*) have been issued also to the Union of School-book Publishers, and are to serve as a standard for the educational authorities in forming their opinion of historical textbooks submitted to them for adoption. Until the publication of these historical textbooks, which can scarcely be expected before Easter 1935, these "directive principles" are also to be regarded as guiding ideas for historical instruction in all German schools. We print below a translation, with German words and phrases in parentheses where there may be doubt as to the actual shade of meaning, of the full text of the document.

The directive principles are not intended, and cannot attempt, to give even by implication a survey of the whole material or the manner of its presentation. They rather direct attention to certain important points of view that hitherto have been considered inadequately, if at all, and that must accordingly be given greater prominence (*stärker zur Geltung kommen*) in future.

Prehistory should be mentioned first, since it not only locates the starting point of our continent's historical development in the Central European cradle of our nation (*Volk*), but is further, as a "pre-eminently national science" (*hervorragend nationale Wissenschaft*) (Kossinna)[†], better fitted than any other discipline to counteract the traditional undervaluation of the cultural level (*Kulturhohe*) of our Germanic (*germanischen*)[‡] forefathers.

Then from prehistoric times through all subsequent millennia until the present day, the significance of race must receive due attention; for it represents the ground (*Urboden*) from which all fundamental characters both of individuals and of peoples spring

A further point of view is the idea of nationality (*der völkische Gedanke*) as opposed to the international idea, the creeping poison of which has for the last hundred years been threatening to corrode the German soul itself; for Germans are more prone than any other people to pursue dreams that are not of this world

With the idea of nationality (*dem volkischen*) is intimately connected that of national citizenship (*der volksburgerliche Gedanke*). To-day a full third of all Germans live outside the frontiers of the Reich. Historical study in treating of German history must therefore not be restricted to the area comprised within Germany's frontiers, but must always keep in view the fortunes of our brethren (*Stammesbruder*) dwelling beyond them.

In opposition to tendencies of a different trend, it is to be required that the description of conditions of life (*des Zuständlichen*)—cultural history (*Kulturgeschichte*)—however important it may be for the characterisation of great periods of development, shall not be given pre-eminence over the political history which shapes the fate of nations. This means bringing out the forces that make history, so that the pupil shall not be lost in the bewildering multitude of isolated events, but shall grasp the main lines and deeper connexions and so be assisted in the formation of his political judgment and will (*und so in seiner politischen Urteils- und Willensbildung gefördert wird*).

The heroic idea in its Germanic expression (*der heldische Gedanke in seiner germanischen Ausprägung*), associated with the idea of leadership (*Führergedanke*) of our own day, that is linked with the earliest models of the Germanic past (*der an ältesten Vorbilder deutscher Vergangenheit anknupft*), must penetrate historical instruction at all stages The two together with their inherent heart-stirring power arouse the enthusiasm without which the study of history may easily become for the majority of pupils a tedious accumulation of facts (*Wissenstoff*). The heroic idea, however, leads on directly to the heroic outlook (*Weltanschauung*) which specifically befits us (*die uns artgemass ist*) as a Germanic people, as no other does, and inspires us with ever-renewed vigour in the struggle for national self-assertion (*völkische Selbstbehauptung*) in the midst of a hostile world.

In detail, the following points are still to be noted. The textbooks are to begin with an account of the primeval history (*Urgeschichte*)[§] of Central Europe (the Ice Age) and show how distinct races (Neanderthal, Aurignac, Cro-Magnon) were the bearers of specific (*arteigener*) cultures It can be shown, in primeval history already, that culture is a creation of race. This fact is only obscured, but not cancelled, by the racial mixtures of later times.

From the beginnings of prehistory (*Vorgeschichte*)[§] (post-glacial times) the Nordic and Faelic races spread over North and Central Europe. The principal areas of their distribution, as well as those of the remaining primary races of Europe, are to be illustrated with simple sketches. The history of Europe is the work of peoples of Nordic race (*nordrassischer Völker*); their cultural level (*Kulturhöhe*) is revealed to us not only by the relics they have left in the way of stone and bronze implements, but also by their achievements in the spiritual domain, that science can infer—not least in the highly developed Nordic (Indo-Germanic) parent tongue which has ousted (save for survivals) the languages of the remaining European races.

We take the path to Hither Asia and North Africa with the first Nordic invasions which must have taken place already in the fifth millennium B.C. This is indicated by finds of Nordic skulls in the earliest Egyptian graves and by the early-attested blonde population of the coastal region of North Africa (cf. Lapouge, "L'Aryen, son rôle social", Paris, 1885). The racial origin of the Sumerians is still obscure, but their language permits of hundreds of comparisons with Indo-Germanic roots which could be most readily explained by the assumption of a former upper class of Nordic conquerors (*die Annahme einer ehemaligen nordischen Erobererschicht*). A decisive influence on the history (*Eine entscheidende Beeinflussung der Geschichte*) of Hither Asia was first exercised by the Indians, Medes, Persians and Hittites, originally of Nordic stock (*nordrassischen*). The pupils must live through, as if it were that of their own blood-relations, the fate of these peoples who eventually declined, overwhelmed by the forces of foreign blood (*unter der Ubermacht fremdrassigen Blutes*) after they had created high civilisations in India and Persia

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[*] The German text is published also in the *Nachrichtenblatt für deutsche Vorzeit, herausgegeben von Martin Jahn*, (IX 6), pp 81-84, 1933.

[†] Gustav Kossinna was professor of prehistory at Berlin until his death in 1932, founder of the Gesellschaft für deutsche Vorgeschichte and the periodical, *Mannus*, and author of numerous books amongst which, "Die deutsche Vorgeschichte, eine hervorragend nationale Wissenschaft", had a very wide circulation

[‡] *Germanische* is here translated "Germanic" instead of "Teutonic"; *deutsche* remains "German"

[§] German archæologists divide what in England is generally called "prehistory" into *Urgeschichte*—palæolithic times—*Vorgeschichte*—the Neolithic, Bronze and pre-Roman Iron Ages—and *Frühgeschichte*—the Imperial Roman and Dark Ages.

The history of the Greeks has again to begin from Central Europe. It must once more be insisted that it deals with our nearest racial brothers (*unsere nachsten rassischen Bruder*). Hence too our intimate relation to Greek art, quite different from our relation to Chinese, Japanese or Mexican art. The Nordic Greeks, as conquerors, formed the aristocracy (*Herrenschicht*) in the land. In Attica in the time of Pausanias, Carian was still spoken in the countryside by the indigenous population. Here in the south the struggle of classes (*der Kampf der Stände*) was based upon a contrast of races Both in Athens and in Sparta the full citizens constituted only a minority over against the indigenous population and the slaves; these, at least in Athens, were largely of Asiatic origin Hence with the breaking down of class barriers by the democracy and with the unrestrained mixture of races that followed, hastened by the growing decline in birthrate (*Kinderarmut*) (Polybios!) the fate of the Nordic race in Greece was sealed, and the decay of Greek culture proceeded with such furious speed that in barely 200 years the Greek people sank into complete insignificance. (Information on the racial aspect of this development in Günther, "Rassengeschichte des hellenischen und römischen Volkes".)

The history of the Nordic peoples of Italy must likewise begin in Central Europe, so that here too the racial kinship may be felt The struggle between patricians and plebeians is to be understood mainly (*vorwiegend*) as a racial struggle (*Rassenkampf*)—hence too the particularly fierce resistance to the grant of the right of intermarriage (*Ehegemeinschaft*) to the plebeians The Nordic element in the Romans was nearly worn out in unceasing wars. By the time of Tiberius only six of the old patrician families survived! The overwhelming majority of the total population of Italy consisted of the descendants of Oriental slaves. The hopelessness of their plight was the background for the stoic outlook (*Weltanschanung*) of the Romans. And so by the beginning of our era the denordicising (*Entnordnung*) of southern Europe was nearly complete

The significance of the Germanic folk-migration lies fundamentally in the fact that it brought fresh (*frisches*) Nordic blood into the Roman Empire, degenerated (*entarteten*) as it was through this racial hotch-potch (*Rassenmischmasch*). Hence the new culture of the Middle Ages bloomed (*entfaltet sich die neue Kulturblute*) only where Germanic peoples settled permanently in North (but not South) Italy, in Spain, France, England, but not in the Balkans. The racial influence of the Nordic Varangians (*die blutmassige Einfluss der nordischen Wardger*) in Russia was too slight to permeate the enormous region with civilising force Only the fact that the Germanic ruling class (*germanische Oberschicht*) in Central, West and South Europe was the bearer of medieval culture makes it possible to understand how medieval chivalry at its height exhibits everywhere such a uniform character

More emphasis than heretofore is to be laid upon the greatest achievement of the German Middle Ages, the recovery of the area east of the Elbe (*die Wiedergewinnung der ostelbischen Gebiete*) In this connexion, it must again be insisted with reference to conditions before the migration period that this area east of the Elbe right away to beyond the Vistula was once Germanic national soil (*einst germanischer Volksboden*) at a time when the Slavonic peoples still dwelt as poor fishermen in the Pripet swamps

For the rest, however, the insistence on nationality must not lead to an unfair estimate of the Middle Ages They were a time of very great expansion of German power (*grösster deutscher Machtentfaltung*). The foundation of national States was then achieved in no European country; take, for example, France with its constituent states (*Unterstaaten*)—Provence, Burgundy, Normandy, Ile-de-France and Lorraine.

Modern history reveals for the first time evolution in the direction of the national State Yet from the beginning of the modern period, international influences too make themselves gradually more strongly felt. They lead to a lamentable intrusion of alien elements (*zu einer beklagenswerten Uberfremdung*) into German blood, German speech, German law, German constitutional theory (*Staatsauffassung*) and finally into the whole outlook on the world. In opposition to them the development of German national consciousness is to be brought out; to-day it receives new vigour from the more thorough investigation of our own history (*des heimischen Altertums*). Such contemplation of what is specifically ours (*das Arteigene*) leads to greater emphasis on the bond of blood which unites us to our kinsmen in neighbouring regions and elsewhere abroad. It allows us to hope for increasing recognition in the kindred Germanic countries (*in den stammverwandten germanischen Ländern*), that the Nordic peoples must feel themselves a community united by destiny (*eine Schicksalsgemeinschaft*) upon the maintenance of which absolutely depends the existence of all higher Nordic civilisation.

The last twenty years of our own time must form a principal object of historical study. The terrific experience of the world war with the heroic struggle of the German nation against a world of foes, the disorganisation of our powers of resistance by forces hostile to the Fatherland (*vaterlandsfeindliche Krafte*), the degradation of our nation by the dictate of Versailles and the consequent collapse of the liberal-Marxist philosophy are to be treated as thoroughly as the incipient awakening of the nation, from the Ruhr struggle to the dawn (*Durchbruch*) of the national-socialist idea of freedom, and the restoration of the German national community on the Day of Potsdam

Minister Dr. Frick at the Ministerial Conference of May 9, 1933.

British Industries Fair

THE twentieth British Industries Fair which opened on February 19 is the largest national trade fair in the world. It is a visible and tangible epitome of the range, variety and character of the goods manufactured or produced within the British Empire, since only such goods are permitted to be displayed and no exhibitor may show articles other than those of his own manufacture The three principal sections of the Fair, held at Olympia and the White City in London, and Castle Bromwich, Birmingham, respectively, will remain open until March 2 To trade buyers the Fair is open from 9.30 a m until 7.30 p m. daily, the public are admitted daily from 4.30 p.m until 7.30 p.m , and on February 24 and March 2 they will be admitted throughout the day.

At Olympia the lighter industries are represented, while the furniture and textile industries have their displays at the White City The Birmingham (Castle Bromwich) Section is devoted to the 'heavy' industries such as hardware, sanitary ware, gas plant for industrial and domestic use, building, electricity, engineering, metals, mining and railway equipment.

It would obviously be impossible in a short article to review the exhibits, so as to give anything approaching a representative picture of the character of the Fair All that can be attempted is to direct attention to a few selected points likely to interest scientific readers

One interesting feature to be noticed each year at the Fair is the extent to which new scientific ideas, discoveries and inventions are being applied industrially. Sir Josiah Stamp and other writers have directed attention to the 'lag' between the completion of an invention or discovery, on the laboratory scale, and its routine incorporation, in applied form, in large-scale industrial operations. The annual exhibition of the Physical Society always has some feature or features of novel scientific interest . how long is it before such a new scientific idea becomes routine practice in the workshop ? One may get some indication of the lag by noticing how long it is before the same idea is embodied in some industrial product exhibited at the British Industries Fair.

In the hardware, ironmongery and brass-foundry group of exhibits at Castle Bromwich, the number of chromium-plated products shown indicates how greatly the improved technique of the electrochemical deposition of chromium is being applied industrially—repeating, it may perhaps be said, in this connexion the older story of stainless steel At Birmingham the latest scientific improvements in equipment for general heating and cooking, and in furnaces for the metallurgical industries are exemplified in numerous exhibits. In the exhibition of electrical plant and accessories there are new and interesting features in generators, motors, transformers, rectifiers, condensers, accumulators and switchgear Recent developments in electrification have called for high-speed rotary machines ; and the comparatively new industry—that of plastic moulding —has had its repercussions on the engineering industry by giving an impetus to the production of special presses. Similarly, the demands of motor and aircraft engineering have led to the evolution of acid-resisting and rustless steels and of new light-weight alloys having great tensile strength. All these and many other developments may be seen in the exhibits at Castle Bromwich.

At Olympia an exhibit of special scientific interest is the United Scientific Instrument Exhibit Among the cinematograph machines shown, both for taking and for projecting, there is a pocket cinematograph camera which, by the turn of a switch, can be converted into a cinematograph projector. It is shown by Camera-Projectors, Ltd. At the stand of Messrs. Chance Brothers and Co , samples and mouldings of a selection of optical glasses representing more than one hundred varieties made by the firm are shown. Messrs. Cooke, Troughton and Simms, Ltd., of York, appear in a new rôle, as manufacturers of a complete range of microscopes for biological, medical and metallurgical studies A gas-filled hot-cathode rectifying valve is shown by Messrs Partridge, Wilson and Co , of Leicester, for the conversion of alternating into direct current. Messrs. Ross, Ltd., exhibit, besides a wide range of their famous camera lenses, including lenses for cinematograph work, a complete portable cinematograph projector and an epidiascope.

A novel and interesting piece of apparatus—called the 'hydro-pulsator'—is shown by Mr Lee Guinness It provides a high-pressure jet of water pulsating at high frequency It is claimed that the apparatus provides a mode of vibratory massage suitable for application to the gums and other parts of the body too sensitive to be touched by the hand, and that by it the teeth may be more efficiently cleaned than by a tooth brush. Messrs. Ensign, Ltd , exhibit the "Ensign Midget", said to be "the most compact camera yet constructed" Besides a complete range of their well-known microscopes, Messrs R and J Beck, Ltd , show a series of workshop projectors by which operatives may see on a ground-glass screen the magnified images of engineering and other products, the profiles of screws and similar components.

The chemical industry is, of course, well represented and the exhibits form a most noteworthy feature of the Olympia Exhibition.

University and Educational Intelligence

BIRMINGHAM —In the annual report of the Vice-Chancellor it is announced that the number of full-time students has reached 1,840 (the maximum yet attained). The increase in the number of medical students is resulting in congestion which can only be relieved by the completion of the new Medical School adjoining the new Hospital Centre near the University Buildings. A beginning has been made with the Hospital Centre and the work is progressing rapidly, but the magnitude of the scheme is such that it is not expected that the first instalment (of 500 beds) together with the complete Medical School, will be ready before the autumn of 1937. An increase in the accommodation for the Department of Chemistry is also urgently needed, but as the estimated cost is £50,000, this cannot be undertaken until the expenditure required for the Medical School can be definitely ascertained. A chair of applied mathematics is also needed.

In the report the Vice-Chancellor refers to the problem of the quality of University students in general. He considers that of all classes there is not more than about 4 or 5 per cent of the first quality, and the university that can offer the most valuable entrance scholarships is likely to secure the greater proportion of these. On the other hand, there are about 20 per cent who, being much below the average of ability, only just manage to get degrees, and it is these who constitute the 'unemployment problem'

The claims of the Library are again urged: "If our ideal as a University is education and not merely the maintenance of intellectual disciplines, double the sum that we now spend on it would be sound and rewarding expenditure".

Dr. H. P Gilding, formerly reader in experimental physiology in University College, London, has been appointed professor of physiology in succession to Prof. I. de Burgh Daly, who has been appointed to the chair of physiology at Edinburgh.

LONDON.—The title of reader in the University has been conferred on the following in respect of posts held at the Colleges indicated: analytical chemistry, Dr. H. F. Harwood (Imperial College—Royal College of Science); pathology, Dr Joan M. Ross (London (R.F.H.) School of Medicine for Women); statistics, Dr. E. S. Pearson (University College).

OXFORD.—On February 13, Congregation passed the Statute, the preamble of which was approved on January 23, for extending and improving the provisions for the study of forestry in the University. The Statute passed without a division, but considerable opposition was offered to a decree providing a site for the proposed new forestry building in the area of the Parks allotted for the extension of scientific departments, in case a suitable site should not be found elsewhere. In proposing the decree, the Master of Balliol pointed out that the moment had arrived when a definite decision must be taken; the whole future of forestry at Oxford was at stake. If the decree were thrown out, co-operation with the Government would be imperilled. The decree was opposed by Prof R. A. Peters, who denied that the honour of the University was at stake The Colonial Office must have known that no commitment could be entered into without the consent of Congregation Further exploration should be undertaken of other possible sites. The Warden of New College urged that this was not a purely domestic matter, the India Office, the Colonial Office, all the Dominions and Crown Colonies were involved. Those who opposed the decree would run the risk of destroying the centre of higher forestry instruction for the whole Empire Prof F. A. Lindemann said that the proposed site was unsuitable and undesirable. The decree should not have been brought in until other sites had been explored. The general opinion of the heads of scientific departments, though they wished forestry well, was unfavourable to the proposed site. The danger of exceeding the alleged time limit had been exaggerated. On a division, the decree was carried by 122 to 91.

A SHORT Unity History School will be held at Bath on April 20–23, at which discussions in connexion with present risks to peace in the world, the effects of dictatorships on world peace, and the effect of science on world peace will be introduced by Prof. H. Dingle, Imperial College of Science and Technology, Prof. R. B. Mowat, University of Bristol, and Mr. F. S. Marvin. A more extended School will be held at Rome in 1935, when the subject will be "Science in the Modern World". Further information can be obtained from Mrs. K. E Innes, 29 High Oaks Road, Welwyn Garden City, Herts.

FOUR Lady Tata research scholarships, of the value of £400 a year each, will be open for award in June 1934, to men or women of any nationality, for research work in the subject of blood diseases, with special reference to leucæmias. Each will be tenable for a year, from October 1, 1934, and renewable up to a normal maximum tenure of three years Candidates for these scholarships must send their applications in time to be received in London on April 15, addressed to the Secretary, Dr H S Patel, Lady Tata Memorial Trust, Capel House, New Broad Street, London, E C 2, or Prof. A. Vacha, Calvinstrasse 27, Berlin, N.W 40, or The Lady Tata Memorial Trustees, Bombay House, 24, Bruce Street, Fort, Bombay, from whom forms of application may be obtained.

Science News a Century Ago

Death of Alois Senefelder

On February 26, 1834, Alois Senefelder, the inventor of the art of lithography, died at Munich at the age of sixty-two years The son of an actor, he was born at Prague on November 6, 1771, and after leaving school studied law at the University of Ingolstadt. His father died early, leaving him to support the family, so he turned to the stage, but with little success Something of a poet, a painter and a musician, he then began to write comedies, and it was through his efforts to produce copies of these that he was led to his invention. Etched copper plates proved too expensive, so he tried writing on a fine white limestone and removing the untouched surface with acid. By about 1797 he had adopted the method of drawing upon the stone with a greasy substance which had an affinity for printing ink. He was granted an exclusive privilege for the process in Bavaria in 1799, and he took out an English patent on June 20, 1801 The next few years were devoted to the development of the new art and in 1809 he was given the post of director of the royal lithographic office in Munich; this position he held with a good salary for the rest of his life. In 1818 he published his "Lehrbuch der Lithographie", in which he gave an account of his discovery, and this was translated in the following year into English by his fellow countryman, Rudolph Ackermann (1764–1834), who had a print-shop in the Strand, London Some of Senefelder's original apparatus is preserved in the Deutsches Museum, Munich.

Aurora Borealis

On February 26, 1834, the *Times*, under the above title, published the following extract from the *Westmoreland Gazette*: "This beautiful phenomenon is not often seen in this part of the world during the day, but at mid-day on Thursday we had something very like it. About 1 o'clock three stripes of pale light emanated from a cluster of fleecy clouds resting a few degrees above the horizon, and about a point to the eastward of north, shooting up beyond the zenith till it came in contact with other clouds, when they melted away; one stream was about mid-heaven, the other more eastward. About half-past one there shot from the same clouds the most beautiful stream of pale light one ever beheld—broad at the base, but extending in width as it shot upwards, not unlike a noble plume of feathers, its progress to the zenith was rapid, but as it passed this point it melted away in ether"

Faraday and Northmore

Faraday's care to give credit to others who had made scientific investigations is recalled by a letter written on February 27, 1834, by Octavian Blewitt (1810–1884), the author of a "Panorama of Torquay" to the editor of the *Philosophical Magazine* The letter corrected a statement made to Blewitt by Thomas Northmore (1766–1851), the Devonshire man of science who had complained that Davy, Faraday and other philosophers had failed to acknowledge his work on the condensation of gases, an account of which was published in *Nicholson's Journal* of 1805–6 When Blewitt brought this to the notice of Faraday, the latter referred to the *Quarterly Journal of Science* of 1823 in which he had said The most remarkable and direct experiments I have yet met with in the course of my search after such as were connected with the condensation of gases into liquids are a series made by Mr Northmore in the years 1805–6" This answer apparently satisfied Northmore who expressed regret that he had been ignorant of this reference

Royal Society, February 27, 1834

Capt de Roos's paper on the operations for raising stores lost in the wreck of H M S *Thetis* off Cape Frio, on the South American coast, was concluded A paper was read by George Dollond, giving an account of the application of a concave achromatic lens to the micrometer, proposed to be called the *macro micro* lens The author stated that by introducing one of the fluid concave lenses recently invented by Prof Barlow, between the object glass and the eye piece of a 5 ft telescope, it became as powerful as a 10 ft instrument The invention had been regarded as one of the greatest improvements made in optical instruments for many years This application of a concave achromatic lens arose out of the series of trials that were made for the purpose of correcting the aberrations of the eye glasses applied to the telescope constructed by the author for the Royal Society

Palestine Association

A general meeting of the Palestine Association, convened by advertisements in the public journals, was held on January 28, 1834, in the rooms of the Royal Geographical Society, Lower Regent Street, and Mr (afterwards Sir) Bartle Frere occupied the chair It was reported that no meeting of the Association had been held since April 24, 1805, and that no steps had been taken to continue the researches in Palestine since the year 1809 It appeared that there remained in the hands of Messrs Coutts a sum of £135 9*s* 8*d* belonging to the Association.

Following discussions in February, it was resolved that steps should be taken to transfer this sum to the Royal Geographical Society to form part of its general fund and to be employed as the council of that Society might think fit for the promotion of geographical discovery Also, that all papers, books, etc, belonging to the Palestine Association be transferred similarly (Minutes, Palestine Association).

Societies and Academies

London

Royal Society, February 15 J C Stimson The electrical condition of hot surfaces (5) The rates at which the steady equilibrium potentials are built up on gold, nickel, platinum, carbon, and copper surfaces after earthing have been studied under varying experimental conditions The rate of charging up of a surface is a linear function of its instantaneous potential, and its logarithm is directly proportional to the reciprocal of its absolute temperature It is extremely probable that the hot surfaces emit positive electricity over the temperature range investigated (up to 850° C) When heated in a vacuum, the emission probably consists of positively charged metal ions, while in contact with gases, the ions are positively charged atoms or molecules of the gas With oxygen at low temperatures however the ions appear to be negatively charged G I Finch and B W Bradford The electrical condition of hot surfaces (6) A series of experiments with a gold gauze surface was carried out in such a manner that the catalytic and electrical activities of the metal could be simultaneously observed and followed The reaction selected was the heterogeneous combination of carbon monoxide and oxygen in both moist and dry systems The electrical condition of the metallic surface was expressed in terms of the magnitude and sign of the equilibrium potential which it acquired in given conditions and its electrical activity was measured by the specific rate at which that potential was approached on insulation at zero or other standard potential In general, throughout the experiments changes in the rate of electrical charging of the metal followed closely the corresponding changes in the catalytic activity, increasing with rising temperature or with the introduction of water, and undergoing similar variations to the rate of reaction when the surface was maintained at constant temperature G I Finch and A W Ikin The catalytic properties and structure of metal films (2) The surface potentials and rates of charging up of cathodically sputtered platinum films in contact with electrolytic gas at room temperature have been determined, and the film structure examined by the method of electron diffraction It is concluded that (1) catalytic action is determined by a prior interaction between the surface and one or both constituents of the combining mixture, whereby the catalyst becomes electrically charged (2) activity is not determined by either crystal size or orientation, (3) catalytic activity appears to be centred round isolated atoms or molecules of platinum not forming part of any ordered array or structure S F Boys Optical rotatory power (1) A theoretical calculation for a molecule containing only isotropic refractive centres (2) The calculation of the rotatory power of a molecule containing four refractive radicals at the corners of an irregular tetrahedron A theoretical formula connecting rotatory power and chemical constitution has been obtained on the basis of the electronic theory of dispersion The rotatory power of any molecule is expressed in terms of the ordinary refractive properties and the linear dimensions by means of certain determinants The expression for the rotatory power is applied to the special case of the molecule containing four radicals attached to one atom, when it becomes quite simple, and theoretical predictions of rotations are compared with experimental data. The formula explains the variation of rotatory power with chemical substitution and also the effects of temperature and solvent The rotatory dispersion is expressed in terms of the refractive dispersions of the radicals in the molecule. The formula also connects the sense of the rotation with the absolute configuration of the compound, and this should be of vital importance in the study of Walden inversion reactions.

EDINBURGH

Royal Society, January 8. Mary G Calder. Notes on the Kidston collection of fossil plant slides (3). Some points in the anatomy of *Sigillaria elegans*, Brongniart. Certain important unrecorded features of the anatomy of *Sigillaria elegans* are described, the specimens on which the description is based having been identified from external characters (4): On the nature of the corona and its relationship *to the leaf traces in the Sigillariæ and Lepidodendreæ*, with special reference to certain diploxyloid specimens in the Kidston collection. In order to establish the affinities of certain diploxyloid specimens, to which the name of "Sigillaria lepidophloioides Kidston MS" had been given, the information regarding the nature of the corona and its relationship to the leaf traces in the Sigillariæ and Lepidodendreæ is reviewed. The specimens are finally referred to *Lepidodendron cf Harcourtii*, Witham David Waterston: New light upon Bishop James Kennedy (1400 ?-1465) from an examination of his remains, recently disclosed during alterations to the College Chapel at the University of St Andrews The skull is mesocephalic, but Alpine rather than Nordic. An endocranial cast shows a large and highly developed brain There had been a fracture of the clavicle which had been treated creditably, a cervical rib, extensive spondylitis of the spine and some occupational modifications. R Grant Studies on the physiology of reproduction in the ewe (3) Gross changes in the ovaries Œstrus is associated with growth and rupture of one or more follicles and interœstrum with the development of endocrinologically active corpora lutea Ovulation is spontaneous and occurs 18–24 hours after the beginning of œstrus Ovulation and formation of corpora lutea occur also during the last month of anœstrum Active corpora are present in pregnancy until about two weeks before parturition In lactation and most of anœstrum, the ovaries are quiescent.

PARIS

Academy of Sciences, January 3 (*C.R.*, 198, 1–128)*. Michel Flanzy: A new method for the microestimation of methyl alcohol in the presence of considerable quantities of homologous alcohols The method proposed, which is based on the preliminary conversion of the alcohols into their iodides, can determine with accuracy one part of methyl alcohol in the presence of 1,000 parts of a higher alcohol. Contrary to the accepted view, methyl alcohol has been found by this method in all fermented liquids. Mme. Ramart-Lucas. *Colour and the structure of* the aromatic oximes. Henri Wahl: The chlorine derivatives of *p*-xylene. Raymond Quelet: A method for the synthetical preparation of the chlormethyl derivatives of the phenolic ether oxides. René Perrin: Reflections on the formation of the earth. J. Dufay: The emission spectrum of the night sky in the ultra-violet region. J. Coulomb and J. de Lagaye: A series of measurements with the Arago actinometer. A discussion of observations made three times daily at the Côte de Landais from 1912 to 1933. There appears to be no exact relation between the radiation and the temperature. The radiation shows two marked maxima corresponding to the two years of maximum sunspots included in the period considered. Jean Piveteau · A primordial skull in a Triassic fish from Madagascar. Robert Lami · A new species of *Laminaria* from the Iberico-Moroccan region · *Laminaria iberica*. P. Lavialle and P. Jaeger: The fertility and sterility of the andrœcium. Their relations with staminal polymorphism in *Knautia arvensis*. Robert Lemesle: The various effects produced by *Fusarium anthophilum* on the ovule of *Scabiosa succisa* G Monnot · The action of sero-opotherapy on the production of the fatty matter of the milk in milch cows. The experiments were carried out on various strains of cattle and in different regions with uniformly successful results. The increase in fat claimed is from 25 to 40 per cent, the quantity of milk remaining the same. The animals increase in weight during the treatment and remain in good condition J Branas and J. Dulac: The mode of action of copper mixtures Function of the deposits The value of the treatment appears to depend on the copper dissolved in the mother liquor the deposits on leaves appear to be incapable of furnishing rain-water with sufficient copper to afford any protection Jacques Monod: The *independence of the galvanotropism* and the current density in the ciliated Infusoria E. Brumpt · Parasitic specificity and determinism of egg-laying of the fly *Lucilia bufonivora* Ch Dhéré · The fluorescence of synthetic pyocyanine.

WASHINGTON, D C

National Academy of Sciences (*Proc*, 19, No 11, 939–990, Nov. 1933) Charles A. Kraus and Gilman S. Hooper. The dielectric properties of solutions of electrolytes in a non-polar solvent The increase of dielectric constant plotted against concentration gives curves concave to the axis of concentration, the effect is of a different order from that due to ordinary polar molecules. It is suggested that the electrolyte is present as ion-pairs which with increasing concentration form more complex aggregates. The symmetry of its ions has a marked effect on dielectric behaviour at higher concentrations Evald L. Skau and Wendell H Langdon. The purification and physical properties of chemical compounds (4) A development of a theoretical basis for the behaviour of controlled time-temperature curves. W. E. Castle · The linkage relations of yellow fat in rabbits. Lack of a reducing enzyme in the liver permits carotene to pass into fat storage tissue, thus colouring the fat. The condition is sporadic and has been shown by Pease to be a simple recessive linked with albinism. Castle has shown that a loose linkage exists between colour and brown hair and skin pigmentation. Yellow fat is now found to be linked with the latter. The three genes are in the same chromosome; double crossing-over occurs with less than the expected frequency, indicating 'interference' for a mammalian chromosome for the first time. Th. Dobzhansky Rôle of the autosomes in the *Drosophila pseudo-obscura* hybrids. There are two races of *D. pseudo-obscura* which when crossed give offspring the males of which have either rudimentary testes, or normal sized testes incapable of producing functional sperm This characteristic seems to be due to interactions between the *X*-chromosomes of one race with the autosomes

* Continued from p 267

of the other. Chester Stock: An Eocene primate from California. Five fragments of jaws, apparently closely related to the tarsiid lemurs (*Anaptomorphidæ*) including the Eocene genera *Omomys*, *Hemiacodon* and *Euryacodon*, have been found at Sespe, north of the Simi Valley. Descriptions and photographs of the fragments are given. J. L. Walsh: Note on polynomial interpolation to analytic functions. Selig Hecht and George Wald: The influence of intensity on the visual functions of *Drosophila* For intensity measurement a series of plates bearing translucent bars of different densities were used; for visual acuity, plates with opaque bars of different widths. A single fly in a glass cell is observed when illuminated with varying intensities of light passing through such plates. At low illumination, two lights are discriminated when the ratio of intensities is nearly 100; this decreases with increased intensity (I) to 2·5. Visual acuity varies with log I, increasing in a sigmoid manner with increase of log I. Assuming the reciprocal of $\Delta I/I$ measures visual acuity, the ratios *Drosophila*/bee/man are 1/60/249 for maximum intensity discrimination, and 1/9 4/1110 for maximum visual acuity. The differences are related to the variation in number of elements functional in the retinal mosaic. T. D A. Cockerell and Louise M. Ireland. The relationships of *Scrapter*, a genus of African bees Cytological and morphological details of insects often suggest 'lateral evolution', that is, a type gives rise to new types without itself disappearing. Moreover, various genes appear to remain latent for long periods. As regards *Scrapter*, from Africa, and *Euryglossidia*, from Australia, though superficially closely alike, they seem not to have had a common ancestry with their special generic characters Oswald Veblen: Spinors in projective relativity. A formal development of the generalised Dirac equations. W A. Zisman: Corrections to earlier papers (see Nature, 132, 687, Oct 28, 1933). All values (statistical) of Poisson's ratio are 5 5 per cent too small. The general conclusions are unaffected

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, February 26

Royal School of Mines, South Kensington, at 5 30—Prof J A S Ritson "Explosives and their Use in Breaking Gound" (succeeding lectures on February 27 and 28, and March 1) *

East London College, at 5 30—Prof G I Finch · "High Voltage Oscillographs" (succeeding lectures on March 6, 12 and 19) *

Royal Geographical Society, at 5 30—G. Rayner "Observations in the Southern Ocean" (Geographical Film)

Tuesday, February 27

Royal Society of Arts, at 4 30—Prof C G Seligman "Anthropological Research in the Southern Sudan".

University College, London, at 5 30—Prof. L. Ruzicka "The Many Membered Carbon Rings" (succeeding lecture on March 1).*

Thursday, March 1

Royal Society, at 4 30—C. Sykes and H Evans · "Some Peculiarities in the Physical Properties of Iron-Aluminium Alloys"

A J. Bradley and J. W. Rodgers: "The Crystal Structure of the Heusler Alloys".

Friday, March 2

Bedson Club, at 6.30.—Prof J. Kendall "Elements, Old and New" (Twenty-fifth Bedson Lecture).

Royal Institution, at 9.—Dr. H. J Gough: "Current Research Problems in Engineering".

Geologists' Association—Annual General Meeting A L. Leach "The Isle of Caldey its Geology and Archæology" (Presidential Address).

Saturday, March 3

Royal Institution, at 3—Lord Rutherford. "The Transmutation of Matter" (succeeding lectures on March 10, 17 and 24).

Official Publications Received

GREAT BRITAIN AND IRELAND

The British Electrical and Allied Industries Research Association (Incorporated) Thirteenth Annual Report, October 1, 1932, to September 30, 1933 Pp 117 (London)

The Scientific Proceedings of the Royal Dublin Society Vol 21 (N S), No 2 Some Difficulties in Current Views of the Thermal History of the Earth By Dr J H J Poole Pp 9–22 (Dublin, Hodges, Figgis and Co, London Williams and Norgate, Ltd) 1s

The University of Sheffield Report on Research Work carried out in the Departments of Mining and Fuel Technology during the Session 1932–1933 Pp 28 (Sheffield)

Leeds University Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing during the Session 1932–33 Pp 18 (Leeds)

The Hundredth Annual Report of the Royal Cornwall Polytechnic Society New Series, Vol 7, Centenary Number, Part 3, 1933 Pp xxv xxxix+203–288+12 (Camborne Camborne Printing and Stationery Co, Ltd) 5s

OTHER COUNTRIES

U S Department of Agriculture Circular No 301 The Cyclamen Mite and the Broad Mite and their Control By Floyd F Smith Pp 14 (Washington, D C Government Printing Office) 5 cents

The Snellius-Expedition in the Eastern Part of the Netherlands East-Indies, 1929–1930 Vol 5 Geological Results Part 2 Geology of Coral Reefs By Dr Ph H Kuenen Pp 126+11 plates (Utrecht Kemink et Zonen N V)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 85 Descriptions of New Fishes obtained 1907 to 1910, chiefly in the Philippine Islands and adjacent Seas By Henry W Fowler Pp 233–367 (Philadelphia)

Proceedings of the American Society for Psychical Research Vol 22 The Margery Mediumship—The "Walter" Hands a Study of their Dermatoglyphics By Brackett K Thorogood Pp xix+228+123 plates (New York American Society for Psychical Research)

U S Department of the Interior Geological Survey Water-Supply Paper 730 Surface Water Supply of the United States, 1932 Part 5 Hudson Bay and Upper Mississippi River Basins Pp vi+206 15 cents Water-Supply Paper 735 Surface Water Supply of the United States, 1932 Part 10 The Great Basin Pp v+107. 10 cents Water-Supply Paper 736 Surface Water Supply of the United States, 1932 Part 11 Pacific Slope Basins in California Pp xi+416 15 cents (Washington, D C Government Printing Office)

Smithsonian Miscellaneous Collections Vol. 87, No 19 An Oligocene Eagle from Wyoming By Alexander Wetmore (Publication 3227) Pp 9 (Washington, D C Smithsonian Institution.)

U S Department of Agriculture Circular No 303 Soil Profile and Root Penetration as Indicators of Apple Production in the Lake Shore District of Western New York. By A T. Sweet Pp 30. (Washington, D C Government Printing Office) 5 cents

The Pasteur Institute of Southern India, Coonoor The Annual Report of the Director for the Year ending 31st December 1932, together with the Twenty-sixth Annual Report of the Central Committee of the Association for the Year ending 31st March 1933 Pp 74 (Madras Madras Publishing House, Ltd)

The Imperial Council of Agricultural Research Scientific Monograph No 7 Influence of Manures on the Wilt Disease of *Cajanus indicus* Spreng, and the Isolation of Types resistant to the Disease By Dr W McRae and Dr F J F Shaw Pp iv+68+16 plates (Delhi Manager of Publications) 2 4 rupees, *4s 3d.*

Memoirs of the Asiatic Society of Bengal Vol 12, No 1: Three Arabic Treatises on Alchemy by Muhammad bin Umail (10th Century A D) Edition of the Texts by M Turāb Ālī Excursus on the Writings and Date of Ibn Umail, with edition of the Latin Rendering of the Mā' al-Waraqī by H E Stapleton and Dr. M. Hidāyat Husain Pp iv+213+2 plates (Calcutta. Asiatic Society of Bengal.) 9 rupees

CATALOGUES

The *Engineer* Directory and Buyers Guide, 1934–35. Pp. 248. (London The *Engineer*.)

Watson's Microscope Record. No. 31, January Pp. 24. (London: W. Watson and Sons, Ltd)

The Protexray Tube Pp. 56. (London Cuthbert Andrews.)

Botany and Gardening. (Catalogue No 218) Pp. 40. (London. Dulau and Co, Ltd)

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Management of Industrial Research

THE paper by Dr Friedrich Bergius delivered before the Institution of Chemical Engineers on November 15 last describing the development of the process of wood saccharification up to a commercial scale at Mannheim has a much wider interest than in relation to the actual manufacture of glucose, lignin or acetic acid It provides a striking example of the difficulties which are so frequently encountered in the transference of a process from a laboratory to an industrial scale, but it possibly provides an even more impressive example of the way in which the prosecution of industrial research in one direction reacts to the advantage of industry in many other ways

Dr Bergius laid particular stress on the large amount of experimental work required to find the right form of apparatus and the proper constructional materials In the course of these investigations, a knowledge was acquired of the properties of different kinds of special materials and combinations of materials to protect metal parts against hydrochloric acid, which should be of widespread utility in chemical engineering Apart from this, the successful conclusion of the investigations depended largely on the development of an adequate engineering technique as well as on the solution of the chemical problems involved, and problems arising out of the low conductivity of stoneware, for example, as well as out of corrosion difficulties, were also encountered It is interesting to note that after a satisfactory solution had been found by utilising the principle of direct transfer of heat from a fluid conductor to the solution to be distilled, the introduction of stoneware with a much higher heat conductivity avoided the difficulty by allowing the construction of suitable vacuum stills

The multilateral benefits of industrial research are, however, equally well illustrated in the address which Sir Kenneth Lee delivered before the Royal Institution on December 15, in which a review of the research work leading to the commercial development of creaseless cotton fabrics by Messrs Tootal Broadhurst Lee and Co., Ltd , was accompanied by shrewd and pertinent observations on the general principles of industrial research which are worthy of widespread attention

One of the first points stressed by Sir Kenneth in regard to the direction of industrial research was the selection of a definite objective, and he attributed the successful issue of the research campaign largely to the selection of a definite and appropriate subject It would be easy to multiply examples of success in industrial research which have similarly followed the selection of a target or objective which was worth while and was clearly defined. The manufacture of synthetic indigo, the fixation of atmospheric nitrogen, the hydrogenation of coal, the saccharification of wood, or the development of numerous synthetic chemicals from acetylene, for which the first award for chemical engineering to a company was made to the Carbide and Carbon Chemicals Corporation at the Fourteenth Exposition of Chemical Industries, New York in December—these are all examples of investigations in which the first step was the definition of an objective worthy of the expenditure of effort involved

Although such examples are so familiar, it is scarcely sufficiently realised that industrial research is largely a matter of selecting appropriate targets or objectives, and that such selection forms a large part of the science and art of research management Success in this field to-day is largely a matter of clearly visualising objectives which are worth while and bringing to bear on them a team of highly skilled research workers equipped with all the technical resources which the modern industrial research laboratory can place at their disposal.

When this has been said, however, it must be admitted that a considerable amount of accurate fundamental knowledge is essential if wise selection of research objectives is to be practised It is precisely the absence of a more or less accurate knowledge of the broad outlines of their field in which certain industries in Great Britain are deficient, and until they have built up such a general body of scientific knowledge covering the principles and practice of their industry, then the research they prosecute is unduly at the mercy of chance. Sir Kenneth Lee, for example, emphasised how the absence of previous systematic research in the cotton industry necessitated much fundamental research before any real progress could be made with the specific problem of producing a creaseless cotton fabric, and how the growth of such knowledge contributed to the clearer definition of the research objective

The selection of an appropriate objective and the existence of an adequate foundation of scientific knowledge are as important to successful industrial research as they are indeed to the successful conduct of industry, whether of an old established industry such as the textile industry or of the new industries such as rayon, dyes, radio, etc., which are firmly based on scientifically established facts Equally important, however, is the matter of team work Industrial research is rarely a matter for one class of research worker alone. Co-operation between chemist, engineer, physicist and others is almost always required, and freshness of outlook and capacity to conduct research are often more important than a prolonged technical experience, which may make for less receptiveness to new ideas Moreover, in the difficult intermediate stage between laboratory success and actual manufacture, the man with a good general training may be more useful than the brilliant but sometimes over-specialised research worker

It is this overlapping of various sciences in industry which makes the multilateral or incidental advantages of industrial research so important and also, apart from success or failure in the main objective, tends continually to raise the general standard of day-to-day practice in an industry which encourages research On this ground alone, Sir Kenneth Lee's assertion that the time is opportune for a considerable expansion in industrial research in Great Britain is thoroughly justified.

Relevant to this question is that of service, to which Sir Kenneth also alluded The selection of valuable objectives is largely dependent on an accurate and scientific knowledge of the principles and practice in the various industries in which the products of a particular industry are used As Sir Kenneth pointed out, the three main defects of goods sold by his company have all been overcome by research conducted either by themselves or by other industrial firms the fastness of the dyes has been greatly improved the creasing difficulty has been solved , and a solution has also been found to the shrinkage problem There are indeed few fields in which the advantages of industrial co-operation are more obvious than in the matter of continuously raising the standard of service given by the products of an industry

Despite the considerable volume of industrial research now being carried out in Great Britain, there are many signs which indicate that industry as a whole is far from making full use of research. Even such a rough pointer of research activity as the number of patents taken out in different countries indicates an alarming disparity in the number of patents taken out in Germany or the United States as compared with Great Britain by persons resident in those countries. Moreover, even the newer industries, which are based on scientific knowledge and are vigorously prosecuting research, are often paying heavy tribute to foreign countries in the form of licences to work fundamental processes covered by master patents. The number of industries in which the fundamental discoveries and master patents are of entirely British origin is disappointingly small.

It is true of course that the position is steadily improving in certain industries, such as the electric lamp industry and also in metallurgy, by the expiry of some of the master patents, but that improvement can only be temporary unless British industries, through a vigorous research policy, are able to claim a full and progressive share in the discoveries upon which further industrial developments are based. The subjects for research are almost legion. To select the major and most profitable problems for investigation is an embarrassing task and may well demand, as a first step, commercial research—the analysis of market probabilities and possibilities, the interplay of main products and by-products, the effect of displacing existing by new products—linked with scientific knowledge, wide vision and sound judgment, on a scale which is still by no means common in British industry.

This plea for research as an essential element in business policy is all the more opportune when the whole question of financing industrial research is under consideration. Whatever plans may be evolved by the Government for the endowment of industrial research and for stabilising that endowment, so as to eliminate the threat of day-to-day financial and economic exigencies whether in public funds or industrial prosperity, the need of vigorous internal prosecution of research by industry remains. This is not even a matter for international trade alone. It is equally important in the home market, where opportunities are largely dependent on the adoption of adequate development policies by unrelated industries.

We have come at last to the realisation that the condition of an industry is not solely a matter for that industry alone. A depressed industry depresses other industries, and if that industry is depressed primarily or even partly because of its own negligence of inefficiency, public interest now demands that appropriate measures be taken to remove that neglect of inefficiency. Sir Kenneth Lee's exposition of research and business policy is a valuable reminder of the factors which make for industrial success and prosperity. Dr. H. Levinstein recently asserted that much of the progress achieved by Japan in recent years is to be attributed to Imperial endowment of the Institute of Physical and Chemical Research. We have undoubtedly the necessary scientific ability to undertake all the industrial research required, whether of the fundamental or technical and semi-commercial kind. What must be brought to bear are the trained intelligence and restrained imagination which are adequate to plan the research required to make full use of all our available resources, and, while continuously raising the general standard of everyday industrial practice, to secure also such a share in the developments of industry as will enable us to meet foreign competitors on equal terms in regard to technical skill, industrial efficiency and freedom from patent restraints.

The Technique of Human Genetics

Nature and Nurture: being the William Withering Memorial Lectures on "The Methods of Clinical Genetics" delivered in the Faculty of Medicine of the University of Birmingham for the Year 1933. By Prof. Lancelot Hogben. Pp. 144. (London: Williams and Norgate, Ltd., 1933.) 6s. 6d. net.

IT is a significant fact that in recent years the editorial columns of NATURE have become more and more concerned with the relation of science to the State. These articles give expression to the conviction which has been growing among men of science that they have certain responsibilities to the community in which they live, and that they should no longer be diffident in offering to help in the solution of the social and economic problems which beset it, by the application of the scientific method in which they have been trained and the special knowledge which they possess. The book under review, which is written by the professor of social biology in the University of London, is a summary of recent work on one phase of the application of science to human affairs, and is therefore of more than purely parochial scientific interest; at the same time the scientific community will be glad to see such problems are being treated with the earnestness, daring and caution which are characteristic of the scientific spirit.

The particular aspect of human biology in which Prof. Hogben has interested himself is heredity. The genetical study of plants and of animals other than man is already in an advanced stage: genetics is in a position to give a causal account of its data which is as complete and coherent as any which can be offered in other branches of biological inquiry Its practical triumphs, the creation of new species in plants, and of new animal varieties adapted to particular functions, seem to offer Utopian promises to the human geneticist But in reality there are very great difficulties in applying to man even the theoretical results derived from genetical analysis of animals, and until this is done any considerable attempts at the practical application of modern genetical methods of breeding must be considered premature In this book Prof Hogben confines himself to the preliminary question of a rigorous analysis of the genetical mechanism underlying the variability of human beings, and has left on one side the problems of its experimental modification His discussion of the methods of analysis is straightforward and enables the reader to form some estimate of the validity of the arguments, which one hears more and more frequently, proposing concrete eugenical reforms.

The human geneticist, since he cannot undertake any experimental breeding, must adopt analytical methods which are rarely employed in animal genetics, and which are therefore still in their infancy These methods are primarily statistical The general principle is to deduce, from the ascertained Mendelian laws, the proportions of different phenotypes which would be expected in the population on several different hypotheses, and then to decide which of these conclusions is best borne out by the facts Such a procedure was, of course, impossible until the general laws of heredity were thoroughly known and securely based on observations with animal material

It is always desirable, and frequently necessary, to develop and examine several different consequences of each hypothesis which it is desired to test The demonstration of the existence in man of rare recessive characters, which a geneticist would expect on general grounds, provides a good example of the kind of difficulty met with. If a character is determined by a rare recessive gene, some matings between an affected and a normal parent will give rise to affected offspring, the normal parent being in this case heterozygous for the gene in question, while other such matings will give no such offspring, the normal parent being homozygous dominant We can calculate the proportion, among all affected by normal matings, of those which give at least one affected offspring The formula depends on the frequency of affecteds in the population as a whole. When this formula is applied to the figures available for various abnormalities (such as albinism, p. 52 *seq*) it fails to fit

This failure may be due to the concentration of the gene for albinism in a small local section of the population, within which its frequency may be considerably higher than in the community at large Other tests must therefore be applied, and Prof Hogben discusses several possibilities On p 72 he investigates the expected proportion of affecteds normals among the offspring of matings between two heterozygous parents, and between a heterozygous and a recessive parent The animal geneticist expects, and obtains, a 3 1 ratio in the first case and a 1 . 1 in the second But, as usual, the human geneticist immediately finds himself in difficulties, because the only practicable way of differentiating these two types of matings from matings involving a homozygous dominant parent is the fact that they give rise to recessive offspring Now many human families are so small that statistical expectations are not realised, and the expected recessives may therefore not appear

Several methods, one of them due to Prof Hogben, are available for adjusting the expected ratios to include this complicating factor Even with these refined methods, however, it is not always possible to decide whether a given abnormality is inherited strictly as a Mendelian recessive, since in some circumstances it is impossible to distinguish between this hypothesis and the hypothesis that the character is dependent on the presence of both of two independent dominant genes Prof Hogben produces another weapon from his armoury to deal with such cases If a recessive gene is rare, that is, has not spread through the whole population, many of the heterozygous carriers of it will be descended from the same ancestors Marriages between such related individuals will, therefore, be more likely than random matings to produce affected offspring. Reversing this argument, it is possible to calculate what proportion of all recessives have related (for example, first cousin) parents (p 59).

This outline of the analysis of rare recessive characters has been carried far enough to show the difficulties which stand in the way of exact work in this field. It is no longer sufficient to identify the hereditary basis of human characters by purely qualitative considerations The study of human genetics will only advance when exact quantitative methods can be applied to a rich supply of data It is the particular merit of this book that it gives a short account of nearly all the most important techniques for exact work of this kind Some of these techniques are due to the original researches of Prof Hogben, but in this set of lectures he is more concerned to give an easy exposition of the principles involved than to provide mathematically unassailable derivations of the various formulæ The mathematics therefore are of the order which can be understood by most biologists who have no special training in this field The simplification of the calculations has been most successfully carried out, but the order in which the whole subject is treated is not so happy The matters dealt with in the first four-fifths of the book are complicatedly interwoven and a greater number of cross-references might have made it easier for the beginner to get his bearings

The fifth and last chapter deals with a rather different subject, namely, the problem of assessing the contributions of heredity and environment to the expression of a character Here again the author most happily lays the emphasis on the exact quantitative methods which are available, and this chapter contains the most critical short account of this problem which has appeared in Great Britain since the fundamental pioneer work of Fisher Prof Hogben comes to the conclusion that Fisher's treatment is invalidated by the fact that human individuals live in families, whence arises a correlation between the incidence of gene differences and environmental differences. If two different genetic stocks are kept in different environments, it is impossible to determine how much of the observed difference between them is due to the genetic difference and how much to the environmental difference. The question is in fact strictly meaningless. The eugenical and sociological importance of such conclusions is obvious, and this section of the book, though it makes no pretensions to finality, contains much which should be regarded as indispensable fundamentals in the eugenist's education.

The whole book can be heartily recommended to the attention of all those who are interested in the genetical basis of human variability with the assurance that, although it may need more effort to understand than some of the popular works on such subjects, the reader may have confidence that Prof. Hogben is leading him, not 'down the garden', but up the strait and narrow path of scientific rectitude.

C. H. W.

Modern Photochemistry

Grundlagen der Photochemie Von Prof Dr K F Bonhoeffer und Dr P. Harteck (Die chemische Reaktion, herausgegeben von H. Mark und M Polanyi, Band 1.) Pp viii+295. (Dresden und Leipzig Theodor Steinkopff, 1933) 24 gold marks

IN no branch of physical chemistry is there a greater danger of a divorce between theoretical treatment and experiment than is the case in modern photochemistry The adequate interpretation of band spectra even of the simpler diatomic molecules is a problem requiring no little mathematical skill and ability, a level not frequently attained by the experimenter The authors must be congratulated on producing a volume which, whilst written primarily for chemists, lays stress on the theoretical aspects of the subject. The book is divided into four sections, the first being devoted to the consideration of the Einstein law of photochemical equivalence, the two following to the primary and secondary photochemical processes, and the last to more complex cases of photochemical action

The difficulties which the chemist usually finds in understanding the complexities of atomic and molecular spectra when interpreted by the physicists are practically eliminated in the volume, a feature of which the authors should be proud. Frequent use is made of analogy, which renders the material not only extremely interesting but also very readable One of the most useful sections of the book deals with the behaviour of free atoms, a subject to which the authors themselves have been the chief contributors

The identification of the reaction products formed when hydrogen, oxygen or halogen atoms undergo reaction with simple substances has been the subject matter of investigations only of the last few years, and the collection and critical survey of the results obtained forms one of the most interesting sections in the book. It is clear that whilst some progress has been made in understanding the mechanism of the hydrogen-chlorine reaction, the hydrogen-oxygen reaction bids fair to provide us with a worthy substitute Whilst some would have cared to see the inclusion of a little more material on fluorescence and its quenching both in gases and in solution, the book must certainly be regarded as the best that has yet appeared on the subject

E. K R.

Science and Human Welfare

The Book of Scientific Discovery: how Science has aided Human Welfare. By Dr D. M. Turner. Pp. 259+31 plates. (London, Bombay and Sydney: George G Harrap and Co., Ltd, 1933.) 7*s.* 6*d* net

MISS DOROTHY TURNER (now Mrs. Féjer) has given us an admirable book which would serve well as a foundation for the teaching of the history of science in any school, and yet at the same time is mature and comprehensive enough to be welcome to any adult who does not despise the good things devised primarily for his juniors There is so much to praise that one hastens to discharge one's only grumble. It seems a pity not to have given the few pages which would have been necessary to introduce the work of the Greeks as the indispensable foundation As the book stands, no one would gather from it that the Greek work was indispensable; in fact, where a Greek is mentioned, it is only to point out that he made some mistake or at best a lucky guess We start in the first sentence by "living in the twelfth century", and "searching for what any ancient writer said" to enlighten our ignorance

It is of course right and necessary to insist on the need of constant criticism, and to show that, before the Renaissance, science had been languishing from want of fresh and accurate observation and from the slavish repetition of the errors of Aristotle and Galen. But the fault was Alexandrian and not Greek The Greeks, from whom we derive not only science but also the whole framework of our intellectual life, were critics *par excellence*, and their failure to go further on the path they first opened to mankind, was due not to intellectual apathy but to their too eager wits, to the lack of scientific instruments, to the want of co-ordination between science and industry, perhaps, most of all, to the prevalence of slavery and the slave spirit.

It is also of the first importance from the historical point of view which Miss Turner keeps so well in mind in the rest of her book, to recall both to scholars and teachers, that Western civilisation, of which science is now the chief instrument and leading feature, was founded and built up by the Greeks and their kindred in Rome. The joint work of Greece and Rome is the signal example in the world of the application of the scientific spirit to human affairs.

The merits of Miss Turner's book which most strike the eye, are its great clearness and accuracy of statement, and the way in which she manages to select interesting and significant facts to illustrate the most important turning-points in her story. Her account of Newton is a case in point, with its excellent sketches both of the prisms used in his optical experiments, and of the path of projectiles and of celestial bodies to illustrate gravitation

It is also a great merit to have divided the matter so well into its natural periods Newton's work leads directly to the application of mechanical powers to industrial production. Then comes a chapter on "Science as a Factor in Social Change", in which is included the beginnings of a scientific policy in public health This, as the author rightly sees it, is an integral part of the industrial system, which by grouping the workers in large town communities, enforced the public control of their living conditions and brought on State action both in health and education Subsequent to this she places the beginning of an age in which chemistry became the leading science, to be followed with one, which we are now entering, when biological discoveries have a dominating influence on our ways of thinking She is right to place this last, and right also to deal with it in rather a more summary fashion, as, being herself a teacher on the physical side of science, she is able on that to speak with greater fulness and sureness in detail The biological chapters are, however, perfectly competent and fit in well with the rest. Several authorities, including Prof. Charles Singer and Prof Frankenberg of the Department of Histology in the University of Bratislava (Czechoslovakia), have given adequate assistance in various ways

It is not surprising, in view of the social spirit which inspires the whole book, to find that the author ends with a sound appreciation of the boons which science has conferred, especially on the masses of the workers, and in spite of the added dangers in war and the loss of quiet and natural beauty which have undoubtedly to be reckoned on the debit side. Unfortunately, too many of us are inclined to dwell rather on the evils than on the good which far outweighs it. Such people may be advised to read Miss Turner's concluding pages. She points out that the spread of science is essentially a popular cause. Before the industrial revolution, "for one happy craftsman there were thousands of starving beggars". The good things of life were far less widely distributed.

"Applied science has relieved man from grinding toil. Leisure is more widespread and appreciation of art and learning no longer confined to the very few. . . . Science bids us take a long view of time." But also a hopeful one. If after the lapse of a few hundred years with their blunders, national jealousies and wars, we have been able to accomplish so much, what may not the future bring, if we have but the common-sense to work together ?

F. S. MARVIN.

Short Reviews

Plant Parasitic Nematodes and the Diseases they Cause. By Dr. T. Goodey. Pp. xx+306. (London : Methuen and Co., Ltd., 1933.) 21*s*. net.

DR. GOODEY has for more than twelve years carried out investigations on eel-worms, and his special qualifications have enabled him to produce this practical account of parasitic plant nematodes with its admirable illustrations. He describes the general structure of a nematode and the technique of preparing these worms for microscopic examination and explains the significance of the formulæ originated by Cobb and refers to certain matters of nomenclature which affect the names of the worms. He then passes to the consideration of the species of *Anguillulina* which cause galls or are otherwise parasitic on shoot structures or are parasitic on roots. In succeeding chapters the species of *Heterodera* which parasitise roots and the species of *Aphelenchoides* are considered, and a chapter is devoted to plant nematodes which are parasites and semi-parasites of doubtful pathogenicity, to saprophytes and to predators.

The usual treatment of each species is to give first a summary of the results of researches upon it, then to state the characters of both sexes and of the eggs and larvæ, to trace the life-history, to note the usual hosts and the symptoms produced in them by the attacks of the parasites, and to refer to the pathology of the plant tissues affected by the worm. The geographical distribution of the worm is stated and the methods of control are concisely described. A final chapter is devoted to the presentation of data on the existence of biological races in two species of plant parasitic nematodes. The evidence presented shows that, for example in *Anguillula dipsaci*, there exist unspecialised polyphagous races, also races which are more specialised and are able to attack few hosts, and other races which are highly adapted and can live on only one or two host-species.

The author is to be congratulated on the sustained lucidity and practical outlook of his book, qualities which will ensure for it a welcome from zoologists and plant pathologists.

The Wright Encyclopædia of Gardening. By Walter P. Wright. Pp. xvii+624. (London and Toronto: J. M. Dent and Sons, Ltd., 1933.) 15*s*. net.

THOSE who have known, and used with profit, the "Everyman Encyclopædia of Gardening", will be interested in this new and greatly enlarged development of those two handy volumes. After a sketchy chapter entitled "Introductory Memoranda" there follows a good and well-illustrated glossary of terms. The main substance of the book consists of an alphabetical list of plants and gardening operations, including larger articles on specific sections such as annuals, fruit orchards, herbaceous borders, vegetables and so forth. Subsequent chapters include a gardening calendar, that 'hardy perennial' so invariably found in any book on gardening in general, an "Outline of Garden Science" in which the elementary physiology and anatomy of the growing plant is presented in a brief but adequate form, an article on "Home Landscape Gardening", which might well have been included in the main text, and finally a chapter on the making of garden structures such as green-houses and frames, summer-houses and numerous rustic articles.

As a convenient reference book which is not too large to handle with comfort the publication can be recommended, but it is to be hoped that in the next edition some major errors of omission and commission will be corrected. For example, under diseases of apples we find the statement that ammonium polysulphide is a "good remedy" for "Bitter-pit"—a purely physiological affection of apples in store. Again, it is surprising to be told that "nitrogenous fertilisers are valuable according to the amount of ammonia they yield", one of the most widely used nitrogenous fertilisers, nitrate of soda, is rarely assessed in terms of ammonia. Yet one other example, any treatment of the subject of tomato cultivation is incomplete without reference to the *Encarsia* parasite of white fly. With such a simple method of control of that troublesome pest available to anyone, it is scarcely wise to recommend to amateurs the troublesome and dangerous method of fumigation with hydrocyanic acid gas.

The Testing of High Speed Internal Combustion Engines : with Special Reference to Automobile and Aircraft Types and to the Testing of Automobiles. By Arthur W. Judge. Second revised and enlarged edition. Pp. xvi+459+84 plates. (London: Chapman and Hall, Ltd., 1932.) 25*s*. net.

THIS is a revised edition of a book first published nine years ago. In its original form it gave a full and uncritical account of the many ways there are of testing high-speed internal combustion engines on the test bed, on the road, or in the air. It also described the numerous pieces of ingenious mechanism necessary for carrying out these tests. The present volume adds to this earlier account, but the same remarkably inclusive—and uncritical—plan has been followed

The most interesting of the additions is an account of the wonderful Rolls-Royce engine used for the British Schneider Trophy seaplanes and its manner of test. The author describes how this engine of but 34 litres cubical capacity, giving in its original form 825 h p., was so skilfully modified as to yield no less than 2,300 h p —an increase from 25 h p per litre to no less than 68—with an increase of speed of as much as 1,000 r.p m beyond that of the parent engine

As illustration of the immense ingenuity of modern testing methods, the author mentions the discovery of hair cracks in connecting rods by the painting of the rod after magnetisation with fine iron filings carried in paraffin, and the revealing of cracks in aluminium pistons by oil marks on a dusting of powdered chalk It must be confessed that the text is on occasion obscure One example will suffice the author wishes to say that the capacity of an exhaust silencer must be twenty times the cylinder-swept volume, what he does say is that the capacity of the silencer in cubic feet must be eighty per cent of the cylinder capacity in litres Despite these occasional lapses the book will prove of real value to those engaged in the testing of this prime mover

Suns and Worlds an Introduction to Astronomy By W H Steavenson (The How-and-Why Series) Pp. 104+4 plates (London: A. and C Black, Ltd, 1933) 2*s* 6*d* net

As was to be expected of one who is himself above all a diligent observer, Dr Steavenson has written a book in which the actual appearance of the heavens is given considerable prominence The last few years have seen a number of books on popular astronomy, but the present volume has a great deal to recommend it, partly on account of this circumstance One of the difficulties which beset the writer of popular expositions is the choice of a mental standard for his public, the author must make up his mind whether he is addressing an intelligent schoolboy, a casually interested adult, or an enthusiastic and painstaking reader Dr Steavenson starts off by explaining the seasons and the phases of the moon, but he goes right on to give an account of galactic rotation The mathematics is suppressed, but the general line of the argument is sometimes given Judging by the phases of the moon, which we usually see expounded in fairly elementary school-books, Dr Steavenson has chosen for his public the intelligent schoolboy. and judging by the rotating galaxy—but why not the schoolboy too? There is a lot to be said for astrophysics as an academic exercise for the young, and it is a pity that it is not a school subject. Astrophysical work involves a peculiar mixture of mathematical and general reasoning, and would provide an excellent mental gymnastic. But this is a digression; Dr. Steavenson is out to interest more than to instruct, and in this we can have no doubt but that he has succeeded.

The Methods of Cellulose Chemistry. including Methods for the Investigation of the Compound Celluloses By Dr Charles Dorée Pp x+499. (London: Chapman and Hall, Ltd, 1933.) 21*s*. net.

THE title of this book and the name of the author provide an indication of an excellence which is not belied by its contents. Dr. Dorée has, in fact, succeeded admirably in his stated object of providing a collection of the best available methods for the experimental investigation of cellulose and of its associates and derivatives. He has achieved this by drawing lavishly, but with discretion, on the literature of chemistry, physics, botany and biochemistry, and on the technical side, from journals dealing with textiles, paper, dyeing and colloids, and he has supplemented this information by his own original work and tests of the methods concerned Theoretical discussion of experimental data is, perhaps wisely, avoided

The methods are classified in three sections dealing with normal cellulose, its synthetic derivatives and compound celluloses The latest developments in determinations such as of viscosity, of degradation products of celluloses and of α-cellulose are treated fully, and will make special appeal to the worker in industry, who in the past has usually had to build up a composite method of his own from the numerous published alternatives The section on woods neglects some important work carried out in Australia which will probably result in fundamental modification of the methods of wood analysis J. G.

Analytic and Vector Mechanics By Prof. Hiram W. Edwards. (International Series in Physics) Pp x+428 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1933) 24*s*. net

THIS useful work is well adapted for students entering upon a university honours course The notation and fundamental principles of vector analysis are fully explained, and vector methods are freely though not so forbiddingly employed as to repel a generation which still finds it easier to think in terms of Cartesian methods than to apply a vector calculus *ab initio*

After chapters which deal with velocity and vectors, the author develops the subject by way of the traditional topics handled clearly and skilfully Harmonic motion, the dynamics of translation and rotation, elementary statics (including attraction and potentials), central forces, particle motion in fluids with resistance, and damped harmonic motion—these headings give a conspectus of the principal topics leading to chapters on vector fields, precessional motion, Lagrange's equations and Hamilton's principle. Physical applications are kept well in the foreground, and, while the treatment of such fundamental physical problems as the definition of mass might very well be extended, junior honours students in physics will find the book reasonably well suited to their needs. A. F.

The Positron*

By DR CARL D ANDERSON, California Institute of Technology, Pasadena, Calif

THE existence of free positive electrons or positrons was first reported by me in September 1932[1], from cosmic ray experiments carried out at the California Institute of Technology In the original paper, all possible alternative interpretations of the effects there presented were discussed in detail, and it was shown that only by calling upon the existence of free positive electrons could those effects be logically interpreted

As a part of Prof R A Millikan's programme of cosmic ray research, in particular to make energy measurements of the cosmic ray particles by the use of a vertical cloud chamber in a very powerful horizontal magnetic field, photographs were first taken in August 1931 in such an apparatus involving the maintenance of a field of strength up to 20,000 gauss over a space measuring 17 cm × 17 cm × 3 cm As reported in lectures in Paris and Cambridge, England, in November 1931 and published in March 1932 by Millikan and myself[2], this work brought to light for the first time the fact that nuclear effects are of primary importance in the absorption of cosmic rays, as demonstrated by the frequent occurrence of associated tracks or showers containing particles of positive charge as well as those of negative charge

Through the insertion in May 1932 of a lead plate across the centre of the cloud chamber, it was possible to show definitely in several cases that the mass of these particles of positive charge could not possibly be as great as that of the proton The direction of motion of the particles was given in two ways: first, by allowing them to pass through the lead plate and suffer a loss in energy, and secondly, by the observation in several instances of two or more tracks all originating at one small region in the material surrounding the chamber For a given curvature of track, the specific ionisation showed that the mass was small compared with the proton mass, but even more definite evidence was gained from an observation of the range of the particles. The observed ranges were several times, in some instances more than ten times, greater than the possible ranges of proton tracks of the same curvature.

These considerations were the basis of the report announcing the existence of the free positive electron or positron published in September 1932. Within the next five months a large number of confirmatory photographs revealing unambiguously the existence of positrons was taken, and a second report was published in March 1933[3] in which fifteen of these photographs were discussed. The specific ionisation exhibited by the positron tracks on these photographs showed that the magnitude of charge of the positron could not differ by as much as a factor of two from that of the free negative electron, and it was, therefore, concluded, unless one admits fractional values of the elementary unit of charge, that the free positive and negative electrons were exactly alike in magnitude of charge This fact, together with the curvatures measured in the magnetic field of a positron before and after it penetrated a plate of lead, fixed its mass as not greater than twenty times that of the free negative electron

Since then[4], an observation of a collision between a moving positron and a free negative electron in the gas of the chamber revealed, on the basis of the conservation laws, that its mass was equal to that of the free negative electron with an error of not more than 30 per cent. More recent measurements[13] of the specific ionisation of the positives and negatives for both high and low speed particles, by actual ion-counts on the tracks in the magnetic field, showed the specific ionisation of the positives and the negatives to be equal to within 20 per cent This fixes the limits of difference between the positives and negatives with regard to their charges and masses at 10 per cent and 20 per cent respectively Further details of the history of this discovery were presented at the American Association for the Advancement of Science meeting in Chicago in June 1933[4]

In March 1933 confirmatory evidence for the existence of positrons was presented by Blackett and Occhialini[5], based on similar experiments with a vertical cloud chamber operating in a magnetic field of 3,000 gauss and actuated by the responses of Geiger-Muller counters In April 1933 Chadwick, Blackett and Occhialini[6], Curie and Joliot[7], and Meitner and Philipp[8] reported that the bombardment of beryllium by α-particles can produce radiation which results in the production of positrons, though in these experiments it was not possible definitely to identify the nature of the radiation producing the positrons By absorption experiments, however, Curie and Joliot showed that the yield of positrons decreased approximately as was to be expected if the γ-ray rather than the neutron component of the radiation were responsible for their production.

The first experiments proving directly that a γ-ray photon impinging upon a nucleus gives rise to positrons were carried out at the Norman Bridge Laboratory, using the γ-rays from thorium C'', and reported in April 1933[9] In this paper the fact that free electrons of both positive and negative sign are produced simultaneously by the impact of a single γ-ray photon, an observation of considerable theoretical import, was first presented Preliminary results of energy measurements were given in June 1933 by Neddermeyer and myself[10] Curie and Joliot[11] in May 1933, and Meitner and Philipp[12] in June 1933, all of whom used γ-rays from thorium C'', also reported the detection of positrons from the same source. Curie and Joliot[13] have also shown that positrons are produced directly in the disintegration of aluminum and boron by α-particle bombardment. The positrons in the case of aluminum cannot here be produced by the internal conversion of a γ-ray photon unless the probability of such internal conversion is vastly greater than that to be expected on theoretical grounds[14] Rather do these experiments indicate that an elementary positive charge is actually removed from the disintegrating nucleus and appears as a positron

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* Address delivered at the Symposium on Nuclear Physics of the American Physical Society meeting in Boston, Mass, on December 27, 1933

The foregoing furnishes in brief a historical survey of the early experimental work on positrons and their production

A detailed study of the energy distribution and frequency of production of free positive and negative electron pairs by filtered thorium C″ γ-rays is of particular value because of the relative simplicity of these effects as compared with those appearing in the cosmic ray range of energies

γ-RAY EFFECTS

A discussion will now be given of experimental evidence as it bears on the theory suggested by Blackett and Occhialini on the basis of the Di electron theory, which postulates the creation of a free positive-negative electron pair out of the absorption of a photon impinging upon a nucleus The nucleus itself in this picture undergoes no disintegration, but plays merely the rôle of a catalytic agent. This discussion will be given in the light of (1) new statistical studies by Neddermeyer and myself on the thorium C″ γ-ray effects, and (2) new experiments on cosmic ray showers by Millikan, Neddermeyer, Pickering and myself

The work of Curie and Joliot, and of Chadwick, Blackett and Occhialini on the radiation from thorium and that excited in beryllium by α-particle bombardment, together with our own work on the cosmic radiation[15], has shown that the absorption process which gives rise to positrons becomes increasingly important with high energy radiations and heavy absorbing materials Further, we have made a statistical study based on a total of more than 2,500 tracks of single electrons, both positive and negative, and positive-negative pairs ejected from plates of lead, aluminum and carbon by γ-rays from radiothorium filtered through 2·5 cm of lead (in some cases with unfiltered rays for comparison) to determine the frequency of occurrence of pairs and single positrons, and their energy distribution for absorbing materials of different atomic numbers The ejection of the particles was observed from lead plates of 0·25 mm thickness, aluminum plates of 0·5 mm. thickness and a graphite plate of 1·4 cm thickness (used also for cosmic ray studies) The magnetic field was here adjusted to 825 gauss

We will consider first of all the energies. Both the single positives and the pairs (the sum of the energies of the positive and negative components being taken) ejected from the lead plates showed a maximum energy of about 1·6 *MV* (*MV* = millions of electron-volts), 80 per cent of the single positrons having an energy less than 0·8 *MV*. For the case of the unfiltered γ-rays, the positrons and the pairs, though occurring in relatively fewer numbers compared with those ejected by the filtered rays, showed also a maximum energy of 1 6 *MV* Further, in the case of the positives and pairs ejected from the plates of aluminum, the maximum energy was about 1·6 *MV*

The maximum energy of the single negative electrons in all cases was about 2·5 *MV* Since the errors in the energy measurements may be as high as 15 per cent, this is in good agreement with the highest energy to be expected for extra-nuclear electrons resulting from Compton encounters or photoelectric absorption of the 2 65 *MV* photons.

n energy of 1 6 *MV* for the positives and the pairs, both from the lead and the aluminum, is in good accord with that to be expected on the Dirac picture if 1 *MV* is allowed for the energy required to create a pair of electrons. There occurred, however, one pair the total energy of which was 2·9 *MV*, it is conceivable, though not likely, that it may have been produced by cosmic rays, or again it may represent the rebound of an electron against the under surface of the lead plate

Of equal importance with the distribution in energy is the distribution in number of single positive electrons and pairs as compared with the single negative electrons Out of a total of 1,542 electrons ejected from the 0 25 mm. lead plate by γ-rays from radiothorium filtered through 2·5 cm of lead, there were 1,387 single negatives, 96 single positives and 59 pairs From an aluminum plate 0·5 mm thick and ejected by the same radiation there were, out of a total of 943 electron tracks, 916 single negatives, 20 single positives and 7 pairs.

The negatives may be assumed to have arisen in general from Compton and photoelectric encounters with extra-nuclear electrons in the lead or aluminum. But the single positives and the pairs must all, of course, correspond to nuclear encounters If we assume that on the average an equal number of positives and negatives results from nuclear impacts, we can calculate the ratio of the nuclear to extra-nuclear absorption This amounts to about 20 per cent for lead and about 50 per cent for aluminum. These values are in reasonably good agreement with those obtained by Chao[16], Meitner[17] and Gray and Tarrant[18] by entirely different methods in the matter of the excess absorption shown by lead over that shown by aluminum and also in the general relation of nuclear to extra-nuclear absorption in both metals.

That the nuclear absorption in carbon is very small for the thorium C″ γ-rays is shown by the fact that, as compared with 415 negatives, there appeared only 2 pairs and 6 single positives

On the whole, the energy relations of the positives and pairs, from both the aluminum and the lead, appear to be quite consistent with the pair-creation hypothesis, as are also the approximate values of the excess absorption in lead and aluminum calculated on this assumption.

The ratio of the observed numbers of single positives compared with the pairs is also of great importance in this connexion Whether a positive is always formed paired with a negative, or whether a positive not accompanied by a negative can in some cases be produced, is a question difficult to answer from the data so far obtained. An accurate calculation of the probability of removal of the negative, if a pair is generated, so that only the positive emerges from the plate, is not simple to make, depending as it does on energy loss and plural scattering in the plate, and on the initial space and energy distribution of the components of the pairs But on the basis of very approximate considerations, it appears somewhat difficult to reconcile the appearance, for example, in the case of aluminum, of 20 single positives and only 7 pairs with the view that they are always formed in pairs Experiments now planned in which the particles are ejected from very much thinner plates should decide this question

One case should be cited in which two negatives and two positives were all observed to originate at one point in the lead plate The possibility that this can represent two pairs accidentally associated in time and position is so remote that it is taken as evidence that *photons of energy even so low as those of the thorium C'' gamma-rays can occasionally give rise to showers such as are a common feature of the cosmic rays*[9].

COSMIC RAY EFFECTS

Our recent stereoscopic photographs taken in a 17,000 gauss magnetic field show numerous showers of more than thirty electrons, some positives and some negatives, originating in lead plates placed across the chamber. In all the observed cases of shower production, it was clearly seen from the photographs that non-ionising particles produced the showers. Also photographs taken in a magnetic field of only 800 gauss showed many examples of single negatives, single positives, pairs and triplets, of energies of the order of only a million or two electron volts, ejected from plates of lead by the impact of non-ionising particles These low energy ejections are in all respects identical with those produced by the thorium C'' γ-rays and are undoubtedly due to low energy photons. These electron effects cannot be ascribed to ordinary neutrons since a considerable study of neutrons in this very range of energies has shown that their absorption results in projected nuclei and not in electron projection or shower formation. The appearance of several such small electron showers on one photograph which contains evidences of showers which occurred above the chamber, brings to light a new fact, namely, that *in the absorption of the cosmic rays there are produced, in addition to the electron showers, in some instances, sprays of large numbers of secondary photons.* The evidences for this conclusion were presented at the November 1933 meeting of the National Academy of Sciences by Millikan, Neddermeyer, Pickering and myself[10], and a full discussion together with the photographs will appear shortly in the *Physical Review*. In one case, more than eighty low energy electron tracks simultaneously projected were photographed, their positions and orientations in the chamber showing that they must have arisen from nearly as many separate centres in the material surrounding the chamber, and must therefore be ascribed to such a spray of secondary photons

That pair production or shower formation by a fast electron (positive or negative) is a relatively rare event is shown by the fact that more than a thousand fast electrons have been observed to traverse a 1 cm lead plate, and only in one instance was a definite pair projected from the lead by a fast electron, while a large number of secondary negative electron tracks appeared as the result of close encounters with the extra-nuclear electrons in the lead plate The immediate secondaries of fast electrons are therefore seen to consist largely of negative electrons and only in rare cases of positrons

Because of the powerful magnetic field we are using, it is possible to deflect all but a very small number of the electrons projected in the showers by the photon impacts In general, in a shower a pronounced asymmetry is noted in the numbers of positive as compared with negative electrons emerging from the lead plates, in one instance 7 positives and 15 negatives, and in a second case 15 positives and 10 negatives These effects are only with some difficulty reconciled with the Dirac theory of the creation of pairs out of the incident photon Rather might they indicate the existence of a nuclear reaction of a type in which the nucleus plays a more active rôle than merely that of a catalyst, as for example the ejection from it of positive and negative charges which then appear in the showers as free positive and negative electrons. The essential difference, however, between these two points of view may be merely that in one case the nucleus may change its charge, and in the other it does not do so

To study nuclear absorption in a light element, more than four hundred successful photographs were taken in which a carbon plate of 1·4 cm. thickness replaced the lead plate. Many of these showed showers originating in a block of lead placed above the chamber, but in no instance was a secondary shower observed in the carbon plate. This indicates, in agreement with the thorium C'' data, the relatively small probability in comparison with lead of a carbon nucleus absorbing a photon by shower production.

A consequence of the pair-theory is that, in a suitably dense environment of negative electrons such as obtains in ordinary matter, a positron shall have a high probability of combining with a negative electron, resulting in the annihilation of both particles and the conversion of their proper and kinetic energies into radiation. The theory, though at present incomplete, states that the mean free path for annihilation is in general greater than the range of the positron, so that such annihilation should be evidenced by the appearance of quanta of about half a million electron-volts energy and a very small number of quanta of about one million electron-volts energy when positrons pass through matter[20] The experiments by Gray and Tarrant[18] on the scattering of thorium C″ γ-rays showed the existence of secondary radiation of such energies, but some of the more recent experiments on the scattering of hard γ-rays fail to show a secondary radiation which can be attributed to the annihilation of positrons Our cosmic ray photographs show that in the electron showers there are present large numbers of secondary photons, many of which are in this range of energy, but it is not yet certain if they are produced in part by the annihilation of positrons In two very recent papers, Joliot[21] and Thibaud[22] report the observation in experiments with artificially produced positrons of secondary photons of the energies to be expected if they arise from the annihilation of positrons By control experiments with negative electrons, they showed that a beam of positrons impinging upon matter results in the production of a considerably greater quantity of photons than does an equal number of negative electrons.

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Research in the Cotton Industry

IN a discourse entitled "Industrial Research A Business Man's View" delivered at the Royal Institution on December 15, Sir Kenneth Lee made some striking references to the place of research in industry, based largely on the actual experience of Messrs Tootal Broadhurst Lee and Co , Ltd Up to twenty-four years ago, they had no scientific staff connected with the business, and it was only experience gained during the War which induced them to make a direct attack by means of research on the production of cotton material like wool in its power to resist and recover from creasing Sir Kenneth proceeded to outline briefly the steps which after fourteen years' work had enabled them to market successfully a creaseless cotton fabric

The initial step was the assembling of the nucleus of a research staff in the belief that, even in such an old-established industry as that of cotton, research could be of immense advantage, systematic work on the chemical and physical properties of cotton or on the physical basis of the machine processes to which it was subjected in the course of manufacture should greatly facilitate uniform and steady progress. Alluding to the lack of such systematic work in the cotton industry, Sir Kenneth cited the process of mercerisation Although Mercer discovered in 1844 that caustic soda had a marked action on cotton, it was nearly fifty years later when Lowe discovered how the conditions must be modified to produce lustre by mercerisation, while Mercer's discovery itself did not attract the active interest of academic scientific workers

In its progress from the bale, through spinning, weaving, bleaching, dyeing and finishing, cotton is subjected to various physical and chemical processes It was therefore decided, when the Research Department was formed, that the staff should consist of chemists and physicists who should work together on the problems involved, and when a laboratory solution had been found, should share their knowledge with technical men in an endeavour to harvest their results in manufacture This was the first time that chemists and physicists had been engaged in co-operation in the cotton industry It was also decided that lack of experience in dealing with cotton should be no bar to the engagement of any member of the staff Provided ability to conduct research was evident, this lack of experience was even regarded as an advantage, since such workers would not have got into ruts and would be more likely to contribute a fresh outlook on the problem.

In addition to the decision to adopt a definite research objective, the further important initial decision was made to carry out routine testing by a separate staff, housed in the same laboratory, so as to provide the maximum contact between the research staff and the analytical or testing staff. The wisdom of the policy embodied in these preliminary decisions is attested not only by the results achieved by the Tootal Broadhurst Lee Co , Ltd , but also by the experience of numerous other industrial research organisations in Great Britain and in other countries

Most of the published work on cotton had previously been concerned with large-scale experiments on yarns and fabrics. In view of the dependence of the physical behaviour of such materials not only on the yarn comprising them but also on the weave, on the twist and diameter of the yarns and the nature of the innumerable cotton hairs, it was decided to commence by investigating the properties of the cotton hairs themselves, the fine fibres about an inch long and a few *ten-thousandths of an inch in diameter* from which all cotton yarns are made. Special apparatus was devised to compare the elastic properties of the various textile fibres in air and in various liquids, and the sponginess of the hairs proved to be of great importance.

It was early realised that there are at least two methods of attacking the creasing problem. One is to fill the spongy cotton hairs with some elastic substance; another is to combine with the cotton some substances which would eliminate its plastic nature and give it the necessary resilience. Both methods were tried and finally the introduction of synthetic resins into the fibre proved successful, though only after some years of work had shown the way to retain all the other textile qualities of cotton when it was impregnated with resin. To be suitable for this purpose, the synthetic resin molecules should be small during the impregnation of the fabric so as to enter the cotton hairs. The substances used must not damage the fabric nor must resinification by heat or otherwise be effected under conditions which damage the fabric. Furthermore, the resin must be colourless and not discoloured by strong sunlight; it must be elastic so as to give the anti-creasing properties, and must be introduced without impairing the suppleness of the fabric. It must also withstand laundry treatment.

These conditions considerably limited the types of resin which could be used. Further investigation showed that when the resin was mainly inside the cotton hairs a soft fabric was obtained, but when a considerable amount of resin was left between the hairs and the yarns, the cloth was hard and stiff. The microscopic examination also showed that the diameter of the cotton hairs is permanently increased, causing the fabric to give better cover, and the treatment accordingly must be directed towards getting rid of all the resin between the fibres. By treating cotton and rayon fabrics in this way, effecting final condensation after the resin solution was put on the cloth, remarkable anticreasing properties were conferred. In addition, shrinkage by washing was reduced while the strength of rayon was increased by 30 per cent when dry and up to 100 per cent when wet.

The next stage of development, from the laboratory to a manufacturing scale, proved difficult as well as costly. In addition to mechanical difficulties, physical and chemical methods of control at each stage of the process had to be elaborated. Not merely the design of suitable machinery, but also the development of suitable testing methods for accurate control made demands on a combination of engineering, chemical and physical knowledge which the man with a general training was often better able to meet than a highly specialised research worker.

One of the major difficulties was concerned with an apparatus for converting the resin inside the cotton hair into insoluble form. This had to be done by running a continuous length of cloth through a machine capable of heating it evenly over its width for a short time to a high temperature. Finally an electrical method was selected, which was novel in the electrical trade, and with this machine a production of some thousands of yards sufficed to gain the experience for the design of full scale plant in which weakness of design and lack of robustness in various details were eliminated.

Discussing the successful conclusion of this research directed to a definite objective, Sir Kenneth Lee raised the question as to how much stronger our industrial position might be as a result of more well-directed research. Patents themselves indicate the extent to which our research activity is overshadowed by that of competitive countries. Even most of our newer industries are handicapped by paying heavy tribute to foreign countries in the forms of licences, and from the results achieved by his own company Sir Kenneth said that they would be glad to see other industries, particularly the older industries, pursuing the same policy to a much greater extent. He considers that the present time is opportune for a great increase in the amount of scientific research in industry, and reduced expenditure on research in other countries offers us a correspondingly greater chance of taking the lead. Researches directed to putting manufacture on a sound scientific basis would undoubtedly repay the expenditure of time, money and patience involved, and the nations doing the most intelligent research work are likely in the long run to have the greatest chance of prosperity. We have in Great Britain the necessary ability for fundamental research if only the business community would supply sufficient funds, and Sir Kenneth urged that there is no wiser expenditure for an industrial undertaking than the provision of funds for research.

Obituary

DR D. H. SCOTT, F.R.S.

WORKERS in the fields of natural knowledge are often described as pioneers in the development of novel views, as men whose enthusiasm was stirred in early life by the preaching of a new doctrine. Dukinfield Henry Scott's early days coincided with an intellectual revolution. He was born on November 28, 1854, a few years before the publication of the "Origin of Species", and graduated from Christ Church in 1876 at a time when men were under the influence of a new gospel. He died on January 29, 1934.

Following the example of other young men of that generation, Scott went to the famous botanical school of Sachs at Würzburg, where he took the Ph D degree On his return in 1882 he took a prominent part as a lecturer and later as assistant professor in applying modern methods at University College, London A member of a family of distinguished architects, he was attracted to the works of Nature rather than to the works of man throughout life he experienced the joys of a true naturalist From 1885 he occupied the chair of botany at the Royal College of Science until 1892, when he accepted an invitation from the Director of the Royal Botanic Gardens, Kew, to be honorary keeper of the new Jodrell Laboratory; two years later he was elected fellow of the Royal Society

Scott's earliest papers, the first of which was published in 1881, were on the latex-bearing vessels in certain rubber trees, on Algæ, and on the anatomy of *Ipomœa*. His last paper was published in 1933. Throughout life his botanical interests were wide and progressive while faithful to the traditions of the older school of naturalists and great systematic botanists, he devoted himself mainly to the investigation of extinct plants, particularly those from the forests of the Coal Age. In an address delivered in 1909, when, as president of the Linnean Society, he opened the new botanical laboratories at University College, London, he spoke of the late Prof W. C. Williamson as a friend to whom he perhaps owed more than to any other man, as it was Williamson who interested him in the subject of fossil botany

The veteran botanist at Manchester had contributed nineteen memoirs on "The Organization of the Fossil Plants of the Coal-Measures" to the Royal Society (1871–93), but comparatively few botanists in Great Britain realised the full significance of Williamson's work, and this was largely due to the presentation of the results in language unfamiliar to students whose sense of proportion and appreciation of values suffered through inability to make allowances for old-fashioned terminology and ideas On his retirement from Manchester, Williamson asked Scott to collaborate with him and, fortunately for the botanical world, a favourable reply was given. In a prefatory note to the first of a series of three memoirs—"Further Observations on the Organization of the Fossil Plants of the Coal-Measures"—Williamson wrote. "My morphological enquiries seem to have reached a stage that makes a more minutely careful examination of these questions of development and growth desirable, but before specially undertaking this, I saw clearly the extreme importance of doing so in combination with some younger colleague whose familiarity with the details of the physiology of living plants was greater than my own." The conspicuous success of this partnership is evidence of the tact and understanding of the younger man and of the confidence and respect for his companion on the part of an experienced palæobotanist who did not readily change his opinions. Scott's transforming influence was the determining factor in bringing about a more general recognition of the fundamental importance of extinct plants

After Williamson's death in 1895, Scott contributed a series of papers to the Royal Societies of London and Edinburgh, to the *Annals of Botany* and other journals, in which he described many new types. In 1897 he gave an exhaustive account of a remarkable cone, *Cheirostrobus*, which demonstrated the existence in the early part of the Carboniferous period of a reproductive shoot more complex in structure than any previously known vascular cryptogam, recent or extinct This was followed by equally interesting discoveries of many other Palæozoic plants In 1901 Scott gave an account of a cone—*Lepidocarpon*—agreeing in the plan of its construction with the cone of a *Lepidodendron*, but differing in bearing 'seeds' in place of ordinary sporangia. The seed-like bodies were described as nascent seeds which did not and could not be expected to conform "in all the morphological rules that we lay down for seeds at the present day" Scott was not a hide-bound formal morphologist

In all his many contributions to a more exact and intensive knowledge of extinct plants, Scott combined an almost meticulous attention to detail with broad philosophical and cautious views on the bearing of the facts on evolution In 1900 he published as a single volume a course of lectures delivered at University College, London—"Studies in Fossil Botany". in the second and third editions the book is in two volumes. The author's aim was the presentation to botanical readers of results which appear to be of fundamental importance. This book has long been a classic, a scholarly work distinguished by well-balanced judgment and clarity of style In 1911 he contributed to the "Home University Library" a more popular account of the "Evolution of Plants", and this was followed in 1924 by the publication of a course of lectures delivered at Aberystwyth—"Extinct Plants and Problems of Evolution".

In 1904, following a most important discovery by Prof F. W. Oliver that certain seeds known as *Lagenostoma* belonged in all probability to the genus *Lyginodendron*, a plant in habit and in foliage closely resembling a tree-form, a paper was published by Oliver and Scott in which the name Pteridospermeæ was proposed for a group of certain fern-like seed-bearing plants which played a dominant part in later Palæozoic and, as we now know, in early Mesozoic floras. For several years Scott regarded the Pteridosperms as closely related to true ferns and derived from a fern ancestry In 1918 he wrote (in a letter): "I have become a bit sceptical about the Pteridosperms and Ferns; all the comparisons seem to be mere analogies"; at the Bournemouth meeting of the British Association in 1919 he definitely gave up the idea of a fern origin in favour of the view that Pteridosperms represent a long-extinct stock which passed through a fern-like stage. This change of view is characteristic of the man: when, as rarely happened, the weight of evidence was against his original opinion, he did not hesitate to say so.

Scott's influence was by no means confined within the limits of palæobotanical research his "Introduction to Structural Botany", an elementary textbook in two volumes, Part 1 of which is now in its eleventh edition, is a model study of representative examples of flowerless and flowering plants. Mr F T. Brooks of Cambridge is associated with Dr. Scott as joint author of the last edition of both parts

In 1921 Scott was the Wollaston medalist of the Geological Society of London, in 1906 he received a Royal medal and in 1926 the Royal Society awarded him the Darwin medal In 1921 he was awarded the Linnean medal of the Linnean Society He was president of the Linnean Society in 1908–12 and of the Royal Microscopical Society in 1904–6, foreign secretary (1912–16) of the Royal Society, twice president of Section K (1896 and 1921) and a general secretary (1900–3) of the British Association. He was an honorary LL D of the University of Aberdeen and D Sc. of the University of Manchester, also honorary member or corresponding member of many foreign academies and societies

Though neither by inclination nor temperament attracted to administrative work, Scott conscientiously discharged such duties as he felt called upon to undertake · he was essentially a student, a dreamer with a 'passion of the past'; a man with strong international sympathy and a keen sense of justice. On occasion impulsive, quickly roused by unreason, a man of lovable personality to those who knew him well Few men of his age made a stronger appeal to the affection and loyalty of colleagues Scott will be gratefully remembered by many younger men and women whom he treated as equals It is fortunate that he was able to devote the best years of his life to research without the hampering necessity of spending the greater part of his energy in teaching

Scott was happy in the companionship of a wife whose personal qualities were complementary to his own from her he had much help in his work both directly and indirectly He leaves four daughters: his younger son died at school (1914) and the elder son was killed in France (1917) when serving with the Royal Engineers. By friends in all ranks of life, Scott will be remembered for many unrecorded acts of kindness as a botanist he has left a worthy memorial in his work and in the services he rendered to exact knowledge

A C SEWARD

DR. WILLIAM PAGE

WITH Dr. William Page, who died at Middleton in Sussex on February 3, at seventy-two years of age, has passed a singularly gracious personality, whose loss is regretted by a wide circle of friends. A far wider public will mourn, and continue to mourn, the editor of the most extensive and successful attempt ever initiated in Great Britain to produce a comprehensive series of county histories, a task to which Page devoted the last thirty-two years of his life

At the outset, indeed, a very different career had seemed to lie before Page. After leaving Westminster School, he became a civil engineer, and for a time (1880–84) was assistant executive engineer to the Government of Queensland But he already had other ambitions At the age of twenty-five he abandoned engineering, and with his brother-in-law, W. J Hardy, established a firm of record agents and legal antiquaries which achieved considerable distinction, and was engaged in a number of peerage, coronation and other claims During this period Hardy and Page jointly published the "Feet of Fines for London and Middlesex" (1892), and Page was incidentally able to develop that extensive and peculiar knowledge of local and customary history which was to serve him in good stead later In 1902 the Hardy-Page partnership was dissolved, and Page joined Mr H A Doubleday as joint-editor of the "Victoria County History", which had been established two or three years previously, whilst two years later, on the retirement of Mr Doubleday, Page became sole general editor.

The task which Page thereby undertook was immense alike in time and in space, including as it did the history, archæology, geology, botany and zoology of the English counties. Nor was it merely in breadth of knowledge and academic sympathy that the work demanded exceptional qualities in the editor The human problem—the problem of co-ordinating the work of innumerable specialists and local students, of harmonising their divergent views, abilities and eccentricities—drew incessantly upon Page's unfailing patience, courtesy and astuteness The contributions which he collected from these miscellaneous sources necessarily vary in value, but it is rarely that they fall below that high minimum of scholarship which he set himself to maintain On the documentary side, the editor's wide first-hand knowledge was a sufficient guarantee On the architectural side, Page's association with Sir Charles Peers resulted in the evolution of methods and standards which are likely to control all future research of the kind Indeed, these methods have received an enduring sanction in their adoption by the Historical Monuments Commission (England), which is in many ways the child of the "Victoria County History".

Nor did the editor's human problem end with his contributors. Financial difficulties were never far from Page's mind, and more than once the "History" seemed to be doomed to founder on this rock. But Page's untiring courage did not fail him, and on more than one occasion he was able to secure at the last moment the patronage which his work demanded In 1910 the generosity of the late Lord Hambledon carried the "History" forward a further stage, and in recent years, although financial support was increasingly difficult to obtain, individual guarantees facilitated the publication of volumes relating to Northamptonshire, Huntingdonshire, Rutland and Kent. In 1932 Page offered to the University of London, subject to certain conditions, the copyright and unused material—a considerable and important collection—of the "History", and the offer was gratefully accepted by the Court of the University in November of that year The Pilgrim Trust afterwards made a grant to the University of £500 a year for three years to assist in carrying on the work, and a University Committee associated with the Institute of Historical Research was established for the purpose It is indeed difficult to imagine that a task so well and truly begun, and already carried so far, should be allowed to lapse, and it is scarcely necessary to express the hope that, in accepting the legacy of Page's great work, the University has accepted the responsibility of completing it.

Page never courted any sort of recognition for his devoted work, but he was long a distinguished fellow of the Society of Antiquaries, of which he was a vice-president from 1916 until 1920, and in 1932 he received the degree of hon D Litt (Oxon)

WE regret to announce the following deaths

Baron Alphonse Berget, professor of physical oceanography in the Institut Océanographique, Paris, who published many works on physics and meteorology, on December 29, aged seventy-three years

Prof F. W Hardwick, emeritus professor of mining in the University of Sheffield, a past president of the Midland Institute of Mining, Civil and Mechanical Engineers, on January 24, aged seventy-three years

Prof T. E Peet, reader in Egyptology in the University of Oxford since 1933, formerly Brunner professor of Egyptology in the University of Liverpool, on February 22, aged fifty-two years

Sir Vincent Raven, K B E, president of the Institution of Mechanical Engineers in 1925, who published several works on electric locomotives and traction, on February 14, aged seventy-five years

Prof. Howard C Warren, professor of psychology in Princeton University since 1914 and editor of the *Psychological Review*, on January 4, aged sixty-six years

News and Views

Fundamental Cosmological Problems

PROF. M. N. SAHA, in his presidential address to the Indian Science Congress at Bombay delivered on January 2, dealt chiefly with fundamental cosmological problems. He believes that recent discoveries in nuclear physics will provide the key to the problems of stellar structure In the absence of decisive evidence, he inclines to the view of Kothari and others that the neutron should be regarded as a dipole consisting of a proton and an electron, and he believes that this structure has far-reaching astrophysical consequences. The problem of the ultimate fate of radiation has been radically transformed by the discovery of the positive electron, and the idea that final stagnation of the universe is inevitable is vitiated by the fact that it ignores the possibilities of conversion of radiation into matter and the combination of small into large energy quanta Prof. Saha considers that the experimental fact of "electro-fission of quantum", that is, the conversion of γ-ray quanta of sufficient energy into a pair of electrons, positive and negative, inside the nucleus, may prove to be the realisation, possibly on the cosmic scale, of the first possibility With regard to the second, he sees no theoretical reason why, in the radiation of space (presumably continuous from the hardest rays to visible light), hard cosmic rays may not be the result of fusion of softer quanta He expressed the view that continuous evolution is confined to portions of the universe such as the earth and solar system, the cosmic process as a whole being cyclic

Scientific Organisation in India

THE latter part of Prof. Saha's address was devoted to problems of scientific organisation. The present world is a single economic and cultural unit, and this fact should direct political and economic action. Practical problems can be solved only by the application of scientific principles, and a new educational scheme should be devised by a world's congress of foremost thinkers, with the object of training the coming generation to a proper appreciation of the beauty and powers of science The lack of scientific organisation and preliminary research is particularly obvious in Indian public works, with serious consequences to the vitality of the population and resulting in great waste of money Prof Saha supported the formation of an Indian Academy of Science, organised somewhat on the lines of the Royal Society, which would co-ordinate Indian scientific work, and act generally for the promotion of scientific research and its utilisation in national and international affairs He adduced evidence of the need of such a body, quoting in support of his view the statement of Sir F. Spring on river problems in India, that "more money has been wasted, for want of just such knowledge as a River Commission might provide, than would have sufficed to pay the entire cost of it many times over".

Dinosaur Skeletons in Brussels

WE regret to learn that the remarkable skeletons of the Wealden Dinosaur Iguanodon, which form the most striking feature of the Royal Museum of

Natural History in Brussels, are beginning to decay. The bones are unfortunately much pyritised, and being exposed to moist air, the pyrites becomes oxidised and causes disintegration. The director of the Museum, Dr. Victor Van Straelen, has for some time arranged to treat the more fragile parts with preservatives, but he realises that the only method of permanent preservation is to enclose the specimens in glass cases in which the air can be kept dry. He has accordingly induced the Belgian Government to ask Parliament for a sum of money sufficient to provide the cases. The Belgian Senate, however, after an animated discussion, has refused the appropriation on the ground that the preservation of these fossils is not worth the needed expenditure. To this Dr. Van Straelen has fittingly replied, that if the Belgian nation is unwilling to preserve so great a scientific treasure, the skeletons of Iguanodon should be offered for sale to museums in other countries, which would be glad to acquire them and keep them intact for research. Palæontologists everywhere will certainly endorse this proposition. The Belgian Senate, years ago, provided a large sum of money to obtain the unique collection of Iguanodons and other important fossils from the mine of Bernissart, to the great benefit of science and the enlightenment of the Belgian people. It is to be hoped that the Senate may yet reconsider its present retrograde step.

Ultra-Short Wave Radio Links for Telephony

It is now well known that electric waves having a wave length of less than about 8 metres are of little use for long-distance radio communication, owing to the apparent inability of the ionosphere to deflect such waves back to the earth's surface. For shorter distances and particularly over stretches of water, however, these short waves are being found to have a useful application in providing a radio link in the ordinary land line telephone system. In this connexion, the radio link is an alternative to the use of a submarine cable, and it has the advantages of lower installation cost and ease of maintenance. An experimental two-way circuit of this type, operating on a wave-length of about five metres, was inaugurated by the Post Office engineers across the Bristol Channel in 1932 (see NATURE, 130, 604, Oct. 22, 1932). This radio circuit operates between Cardiff and Weston-super-Mare and links up with the ordinary inland telephone network, thus forming part of the London-Cardiff trunk circuit. The recent opening of a similar radio link, on a much shorter wave-length, across the English Channel for use in connexion with the cross-channel air services was referred to in NATURE of February 3, p. 167.

According to a report in the *Times* of February 24, the Postmaster-General, in his address to the Lincoln Chamber of Commerce, referred to the probable extension by the Post Office of the facilities provided in the radio link across the Bristol Channel. Modern submarine cables usually contain many circuits so that several conversations are possible simultaneously; and a similar facility must be provided by the radio link if this is to compete successfully with the cable. The experimental work which is now being conducted by the Post Office is directed towards ascertaining the practical possibilities of operating, between two fixed points, several small radio transmitters each on a separate wave-length and carrying a single conversation. The necessary equipment for this practical test is now being installed at Castleton, Monmouthshire, and at Backwell Hill, near Bristol. There will be six transmitters and six receivers on each site, and each of these will be associated with its own directional aerial system. All the twelve wave-lengths to be used will be within the range four to six metres. The whole system is being designed for economical operation, and such devices as the automatic charging of batteries and the indication at the controlling telephone exchange of faults on the radio link, are being incorporated. It is hoped to begin the tests in two or three months' time and the results of this larger-scale practical trial will be awaited with interest.

Structure of Chlorophyll A

The fourth Pedler Lecture of the Chemical Society was delivered by Prof. Hans Fischer at the Royal Institution on February 22, his subject being the constitution of chlorophyll A. Prof. Fischer has been working on blood and leaf pigments in Munich for a number of years, and has recently synthesised hæmin, which is obtained from blood by heating with acetic acid and sodium chloride. He was awarded the Nobel prize for chemistry for 1930. The lecturer dealt first with the porphyrins, a group of compounds upon which both hæmin and chlorophyll are based, and which all contain a ring of four pyrrole-like nuclei. Willstätter's work has shown that substances of this type are formed in the breaking down of chlorophyll, but now many of these complex molecules have been synthesised, and the nucleus of chlorophyll is known with certainty to be an isomeric modification of the porphyrin ring. The hæmin molecule has essentially the same nucleus, but different side chains. It contains two vinyl groups, which are hydrogenated to ethyl groups in chlorophyll. The latter also contains an additional ring structure, derived from β-keto propionic-acid, in place of the propionic acid side chain of the hæmin molecule. In chlorophyll, a magnesium atom replaces the co-ordinately bound iron atom of hæmoglobin. The final formulation of the structure of the chlorophyll molecule has entailed an enormous amount of synthetic organic chemistry of the utmost complexity. The brilliant manner in which Prof. Fischer and his co-workers have carried it out makes one confident that they will ultimately succeed in the synthesis of chlorophyll itself.

Bootham School Natural History Society

The foundation of this School Natural History Society in 1834 was an important landmark in educational history, and a largely attended meeting at Bootham School, York, celebrated its centenary. An interesting exhibition of work done by past and present members gave striking evidence of the range of interest and the far-flung activities of Bootham Old Boys. The headmaster read messages of greeting from the Minister of Education, Sir Michael Sadler and many others. Referring to distinguished former members such as Joseph Barcroft, F. W. Oliver, S. P. Thompson, J. Gilbert Baker, Lewis Richardson, Sir George Newman and Henry Seebohm, he claimed that the Society has performed, through the lives of its members, great services to the development of tropical countries, as well as to pure science. Above all, it has given to a great number of men a permanent enrichment of life. Mr. J. L. Paton, formerly High Master of Manchester Grammar School, gave an inspiring address. He warmly commended the pioneering step taken a hundred years ago in bringing biological science into the school. He spoke of those naturalists overseas as conquerors, not of men, but of Nature. Finally, he maintained that men do not really know Nature until they know her as the interpreter or the medium of the supernatural.

The Diesel-Electric Train Ferry *Scilla*

FOR nearly forty years a service of train ferries connecting Sicily with the mainland has been running across the Strait of Messina. The distance between the two terminal points, Messina and Villa San Giovanni, is about five miles. Until recently the service was maintained by two small ships which crossed in opposite directions simultaneously, so as to prevent an accumulation of rolling stock on either side of the Strait. In October 1931 they were replaced by the Diesel-electric train ferry *Scilla*, which has a displacement of 4,000 tons and a length of 358 ft. In *Engineering* of February 23, a full description is given of the vessel. It has a horse power of 5,000 and a maximum speed of 17 miles per hour. The coaches are embarked and disembarked at the end by means of a movable bridge. The adoption of Diesel electric propulsion for a vessel of this type has several advantages, in particular its ability to run economically at different speeds, and rapid and accurate manœuvring. There are two steering stations on the vessel, one on the boat deck and the other in the engine-room, and interlocks are provided so that it is impossible to operate the controls from both stations at the same time. The ferry carries both passengers and goods, and traffic in the latter and more particularly the transport of fruit, has steadily increased since its inauguration. It is of a seasonal nature with a winter maximum, a summer minimum and a short peak load in June. The crossing takes 25 minutes and there are first and second class restaurants on the passenger deck. The corridor deck contains first, second and third class saloons for the passengers.

A James Watt Letter

A MOST interesting letter written by James Watt in 1784 to his father-in-law, Mr. Macgregor, has just been presented to the University of Glasgow by Mr. W. J. Wilson. The letter was published in full in the *Glasgow Herald* of February 9. Watt had once made surveys for the Caledonian Canal, and it had been proposed that he should become the engineer of the scheme. By 1784, however, he had become so fully occupied with the engine business at Birmingham that he felt he could not accept the position. He said, "the contriving of engines and the other necessary attention to a business which is now very extensive takes up all the time that bad health will permit me to work, and it is possible that, setting aside the damage which the distraction of my attention might do to the partnership, my share of the loss in the engine business might exceed my gain by the canal direction." Speaking of his great contemporary Arkwright, Watt said, "he is to say no worse one of the most self sufficient ignorant men I have ever met with. Yet by all I can learn he is certainly a man of merit in his way and one to whom Britain is much indebted and whom she should honour and reward, for whoever invented spinning Arkwright certainly had the merit of performing the most difficult part, which was the making of it usefull." When Watt wrote this letter he was forty-eight years of age, and eight years previously had married his second wife, Anne Macgregor.

Institution of Mechanical Engineers

AT the annual general meeting of the Institution of Mechanical Engineers held on February 16, the annual report was adopted and the ballot for the election of officers declared, Mr. C. Day becoming president for the ensuing year in succession to Mr. A. E. L. Chorlton. Honorary life membership, it was announced, had been conferred upon Mr. L. St. L. Pendred and the Right Hon. Lord Invernairn. The report showed a net increase in the roll of membership of 61 names, the total number of members now being 11,356. The total revenue of the Institution was £34,074. During the year the meeting hall had been much improved and the library accommodation increased. A standing Committee, entitled the Inventions Advisory Committee, had been formed to assist members, while another committee, entitled Works of National Importance Committee, had been established to consider proposals for works of national importance which could be submitted to the Government for consideration with the view of lessening unemployment. The report contains short reviews of the work done by the various research committees, the awards for papers and the results of the examinations for National Certificates and Diplomas in Mechanical Engineering. For these examinations there were 2,989 candidates in England and Wales, 226 in Scotland and 37 in Northern Ireland, a greater number than in any previous year. Twenty National Diplomas (Air) in Mechanical Engineering were awarded jointly by the Institution, the Board of Education and the Air Ministry.

Streets and Pavements in London

IN a paper read to the Newcomen Society on February 21, an interesting sketch was given of the history of the streets and pavements of London. In only two periods in its long history has London been efficiently paved and drained: in the days of the Romans and during the last hundred years. How well the Romans worked can be seen from the remains of causeways and sewers now and again brought to light during excavations in the City. With the departure of the Romans went the art of road-making, and for century after century the citizens accepted with extraordinary complacency conditions which would not be tolerated in any city to-day. As a rule, the roads were unfit for wheeled traffic, the sidewalks were of gravel and dirt, the rain spouts projected over the pavements and such sewers as there were were connected ineffectively with gutters full of holes. Complaints were made over and over again, and though surveyors and paviors were appointed, things were seldom satisfactory. Even in the days of Wren and Newton, Ludgate Hill and Fleet Street drained into the mud-filled Fleet River, which had long ceased to be navigable and had become a nuisance. Westminster was every bit as bad as London, and in 1742 Lord Tyrconnel in the House of Lords said: "The filth of some parts of Westminster and the inequality and ruggedness of others, cannot but in the eyes of the foreigners disgrace our nation, and incline them to imagine us a people, not only without delicacy, but without government, a herd of barbarians, or a colony of hottentots." Improvements were effected from time to time, it is true, but it was only during last century that real progress was made.

Archæological Exhibitions at the British Museum

At the recent annual meeting of the subscribers to the British School of Archæology in Athens, reference was made in the usual review of the School's work to the votive house, or temple, models which had been discovered in the course of the excavation of the Heræum at Perachora, near Corinth. From incomplete fragments a complete model has been reconstructed, which is now on view in the British Museum. The model is about a foot in height, and gives for the first time an idea in detail of the character of the house in the Ægean during the Geometric period. The models are dated at about the middle of the eighth century B.C. The most striking feature of the construction is the apse, which Sir Arthur Evans has suggested may have arisen from the earliest form of building, in which the back wall was formed by hollowing out a cliff face. The door of the building has antæ with columns, and above it are three small windows.

On March 7 an exhibition will open of the finds of the joint expedition of the British Museum and the British School of Archæology in Iraq under the leadership of Mr. M. E. L. Mallowan, at Arpachiyah, near Nineveh, in northern Iraq, during the season 1932–33. This material should have been on view last summer, but its dispatch from Iraq was delayed by action of the Government in settling the allocation of the material found by the expedition. The finds now shown will illustrate the cultures of the ten successive prehistoric settlements discovered at Arpachiyah. This sequence, in which the occurrence and development of the painted pottery can be followed from the earliest settlement, and the evidence of early relations with prehistoric India, Baluchistan, southern Mesopotamia and Crete, make Arpachiyah one of the most important sites known for the early prehistory of Iraq. Unfortunately, partly owing to lack of funds, excavations have been suspended.

Recent Acquisitions at the Natural History Museum

By the will of the late Lieut.-Col. C. G. Nurse, the Trustees of the British Museum (Natural History) have received a bequest of 3,000 Indian insects mostly obtained at Quetta, Deesa and Jubbulpore, where Col. Nurse served with the Indian Army. Col. Nurse was one of the small band of naturalists among military officers who devoted their leisure to the study of entomology, and was an enthusiastic collector of Hymenoptera, forming a large and valuable collection which he presented to the Museum a few years ago. The present bequest comprises the remainder of his Indian insects and includes about 1,450 Diptera (two-winged flies), 1,300 butterflies, 130 dragon flies and some others; of these the most valuable are the Diptera. The collection is especially rich in species of the family Bombyliidæ, most of which are parasitic in the larval state on bees or wasps. Col. Nurse discovered and described fourteen species of this family which were new to science, and types of these are in the collection, as well as specimens of a number of other flies which were not previously represented in the Museum. Some interesting butterflies and other insects from Aden are included.

The Department of Botany of the Museum has been presented with sixty-three bundles of plants by the Hancock Museum, Newcastle-upon-Tyne. These plants were presumably presented to the Newcastle Museum by William Robertson, who bought them at the sale in 1842 of A. B. Lambert's herbarium, which was one of the largest ever in private hands. The specimens are of historical interest as they presumably include the remainder of the herbarium of P. S. Pallas, a Russian botanist who died in 1811. Pallas's plants were acquired by Lambert, who picked out one set for himself and one for Sir Joseph Banks. Banks's set went to the Museum in 1827, and Robert Brown purchased Lambert's own set at the sale. Judging from the specimens so far examined, the present acquisition represents the remainder of the herbarium. Much will probably be duplicate material but a good deal of information can be obtained from the original wrappers in which the plants still are. Further, it is probable that some plants figured by Pallas, which have been missing, will be brought to light. The bundles also contain about 500 plants collected by the Rev. E. D. Clarke, who visited Pallas in the Crimea in 1800. The plants were named by Pallas. Among the purchases are 800 flowering plants from Spain and Morocco (Sennen), 1,500 from North America (Marcus E. Jones) and 900 from Eastern Greece, Ægean Islands, etc. (K. H. Rechinger).

Good Eggs and Old Age

THE man or woman who lives to be eighty years old started as an "extraordinarily good egg" is a conclusion stated by Dr. George L. Streeter, director of the Department of Embryology of the Carnegie Institution of Washington, according to Science Service, Washington Human eggs, like hen's eggs, vary greatly in nature and quality It is estimated that one fourth of the fertilised human ova are not good enough eggs to be born as living individuals Whether the infant survives its first year – and, in fact, a large number of them fail to do this—depends in considerable part on the original quality of the egg The individual who withstands the usual experiences of life until between fifty and sixty years old and then succumbs to its aggregate wear and tear, conforms to the actuary's 'expectation of life at birth' and to the embryologist's expectation of the performance of an egg of average quality It is only the extraordinarily good egg that is still going strong at eighty years, and we see him or her doing this in the absence of any exquisite hygienic regime or environmental favour

Plant Collecting in Persia

THE *Gardeners' Chronicle* is always to the fore in publishing reports of expeditions organised for the collection of new plants In the issue of January 6 appeared the first of a new series of articles on "Plant Collecting in Persia" by Mr. E K Balls The account gives full descriptions of the habitats of a wide variety of plants, particularly irises, campanulas, gentians and *Dionysia* More intimate details of the trip are also included The second article appeared in the issue of January 20, and articles are promised for some time ahead If the plants collected prove amenable to cultivation in Great Britain, many beautiful species will be placed at the disposal of gardeners

International Union for Chemistry

THE eleventh conference of the International Union for Chemistry will be held at Madrid at the same time as the ninth International Congress of Pure and Applied Chemistry Among the matters to be considered by the various commissions of the Union are the reforms of inorganic, organic and biochemical nomenclature, physico-chemical standards; co ordination of scientific terminology; international tables of constants; and finance The election of president and vice-presidents, and the nomination of members of commissions, will take place on April 11

International Congress of Actuaries

THE Tenth International Congress of Actuaries will be held at Rome on May 4–10 The subjects for discussion will cover a large field and particular attention is being given to different aspects of social insurance, including unemployment insurance Various social functions and excursions have been arranged and the Congress promises to be one of the most interesting of recent years The British Government has appointed as its representative the Deputy Government Actuary, Mr. G. S. W. Epps. It is hoped that those Cabinet Ministers whose Departments are specially concerned with actuarial questions will be associated in an honorary capacity with this as with past congresses Membership of the Congress is open to members of the Permanent Committee of International Congresses of Actuaries and, subject to approval by the Managing Committee, to others or institutions professionally associated with actuarial work. Further information can be obtained from Mr Geoffrey Marks, C B E, 39, King Street, E C 2, or Mr. Stuart Cumming, 19, St. Andrew Square, Edinburgh

International Agricultural Congress

THE third Technical and Chemical International Congress of Agricultural Industries will be held in Paris on March 26–31 The Congress will be followed by a tour of the French wine-growing districts, arranged so that those delegates who wish can continue to Madrid in time for the opening of the ninth International Congress of Pure and Applied Chemistry on April 5 The work of the Congress is divided into five main sections scientific and economic studies, sugar manufacture, fermentation industries, food industries, and allied industries The subjects selected for discussion cover a wide range, but will be chiefly of interest to technologists in the sugar and fermentation industries. Other questions to be discussed include water pollution, and new uses for surplus agricultural produce, in Section 1, the properties of wheat and flour in relation to bread quality, and the treatment of milk from the farm to the consumer, in Section 4, the use of alcohol fuels and of vegetable oils in motors, in Section 5 These ensure that the Congress will appeal to a wide circle of agricultural and other technologists Adequate arrangements have been made for relaxation from the more serious work of the Congress The subscription for individual delegates is 100 francs, payable to the Treasurer, M Combrun, 156 Boulevard de Magenta, Paris, from whom application forms and other details may be obtained

The Seventh Achema

WE have received an illustrated leaflet which contains the preliminary announcement of the seventh 'Achema' or Exhibition of Chemical Plant and Apparatus, organised by the 'Dechema' (Deutsche Gesellschaft für chemische Apparatewesen), which will be held at Cologne during Whitsuntide (May 18–27). The event has been timed to coincide with the annual meetings in the same city of several of the leading German allied societies, and the exhibition will be held in three large buildings on the banks of the Rhine and within easy walking distance from the centre of the city. Four years will have elapsed since the sixth 'Achema' was held at Frankfort and the promoters confidently claim that this will be the greatest exhibition of its kind that has yet been held anywhere in the world. Most of the leading German firms who supply chemical plant and apparatus have already booked stands and a big gathering of experts is expected A graph on the pamphlet shows how rapid has been the growth in popularity of this undertaking since the first 'Achema' was held at Hannover in 1920 Admission cards will be issued free on application to the Management, Dechema Gesellschaftsstelle, Seelze bei Hannover. Two international postage stamps should be enclosed A handbook containing fuller particulars will be issued shortly Arrangements are being made by Messrs Hagemann and Co, Travel-bureau, Bad Aachen, Bahnhofstrasse, 32, for the issue of cheap excursion fares from England and other countries

Universal Decimal Classification in Germany

THE past three years have witnessed in Germany a rapid development of interest in the universal decimal classification, the most important manifestation of which has been the adoption of that system by the Deutscher Normenausschuss for codifying its published standards The need for a German edition of the classification has been felt, and is now to be met The production of a new (third) edition of the classification will take place in the next three years, 1934–36, under the auspices of the Normenausschuss and the Ministry of the Interior The work has the official approval of the Institut International de Documentation and will incorporate all the considerable amendments and additions made to the second French edition 1927–29 since publication of the latter The additions will total some 10,000 classes, mainly in science and technology, bringing the total number of classes to approximately 70,000 The work will be published in ten quarterly parts, of standard format *A* 4 and comprising about 160 pages The first part will appear in April of this year, and the cost of each part will be 11 gold marks if ordered before March 1, afterwards 12 50 gold marks Messrs Beuth-Verlag, G M B H, Berlin, S W 19, are the publishers.

The Night-Sky in March

THE only striking planetary object in the March sky is Jupiter, which can be seen in the eastern sky before midnight close to the star α Virginis (Spica), and the two form a conspicuous pair There will be an occultation by the moon of the star α Scorpii (Antares) on March 8, but the phenomenon will not be visible at Greenwich (it will be visible at the Cape of Good Hope) On March 26 the moon will occult δ Cancri, the magnitude of which is 4 2 This occultation will be visible at Greenwich and will take place early in the morning (at 3h 02m G M T) At this hour the phenomenon will scarcely tempt any save regular observers of occultations, especially as we can warn our readers of two occultations which will occur later in the year of bright stars both of which will occur before midnight.

Announcements

THE newly formed Microchemical Club will hold its first scientific meeting on Saturday, March 17, at 10.30 a.m. at the Lister Institute, Chelsea Bridge Road, London. At 2 30 p m on the same day and at the same place, the first annual general meeting will be held to elect officers, adopt a constitution and transact other business Communications on microchemical subjects are invited, they may deal with applications and development of micro methods in any branch of science Communications can be sent to S J Folley, National Institute for Research in Dairying, Shinfield, Nr Reading

THE prize for 1933 of £100 awarded by the Thomas Gray Memorial Trust of the Royal Society of Arts for an essay in connexion with fire in a modern passenger vessel or in a cargo vessel at sea, in port or in a builder's yard has been awarded to Commander R D Binney The prize of £100 for an improvement in the science or practice of navigation has been awarded to Dr A B Wood, F D Smith and J A. McGeachy, Admiralty Research Laboratory, Teddington, for their silent magneto-striction echo sounder with recorder The prizes for 1934 are being offered for an invention, publication, diagram, etc, which is considered to be an advancement in the science or practice of navigation and for an essay on a navigation topic Essays or proofs of claim must be submitted before December 31 Titles of the essay and other information can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, London, W C 2

IN an article on "Industrial Research" in NATURE of January 20, it is stated on p 80 that the contribution of electric supply authorities in Great Britain to the British Electrical and Allied Industries Research Association is about £5,000 We are informed by the Association that its income from this source in 1933 was £15,000

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—A probationary assistant engineer (male) in the Post Office Engineering Department—The Secretary, Civil Service Commission, Burlington Gardens, London, W 1 (March 8) A senior library assistant to the Hertfordshire County Council—The Clerk to the County Council, 28, Castle Street, Hertford (March 10) A head of the Mechanical and Civil Engineering Department of the Technical College, Sunderland—Chief Education Officer, Education Offices, 15, John Street, Sunderland (March 12) A University professor of anatomy at St Thomas's Hospital Medical School—The Academic Registrar, University of London, S.W 7 (May 16) A director of food investigation in the Department of Scientific and Industrial Research—The Secretary, 16, Old Queen Street, Westminster, S W 1 (March 17) A head mistress of the Day Trade School for Girls, Wavertree Technical Institute—The Director of Education, 14, Sir Thomas Street, Liverpool (March 17) A professor of mathematics at the Royal Technical College, Glasgow—The Secretary (March 26) A staff lecturer and demonstrator in botany, and a demonstrator and assistant lecturer in chemistry at the Royal Holloway College, Englefield Green, Surrey—The Principal (April 14). A signal engineer for the Way and Works Department, Government Railway, Ceylon—Crown Agents for the Colonies, 4, Millbank, London, S.W.1.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

A supposed Submarine Ridge along the South-East Coast of Greenland

DURING marine biological work in the Denmark Strait with the Danish Research Ship *Dana* in August 1933, it was possible to proceed quite close to the coast of East Greenland south of Angmagssalik; practically no ice was met with during this year. For the purpose of the biological work on the drift of cod larvæ from Iceland to Greenland with the west-going branch of the Irminger Current, four sections were made from the coast out to deep water. During these sections, as also on the whole cruise, the echo sounding apparatus was constantly used and the soundings revealed—so far as it was possible to carry out the investigations during the time available—that a submarine ridge seems to follow the East Greenland coast, at any rate from about Lat. 64° N. to Cape Farewell (lat. 60° N.).

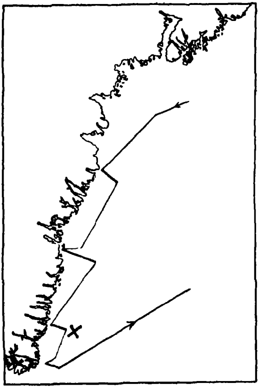

FIG. 1. Course of the *Dana* off the south-east coast of Greenland.

Our work during the cruise was, as mentioned above, mainly marine biology, and it was impossible to go further into the studies of the relief of the sea bottom last summer. The matter is, however, of importance in several respects, and I wish therefore to announce our observation of this supposed ridge that other ships may possibly have the opportunity of making further soundings there and thus eventually prove or disprove the existence of this supposed submarine ridge in these remote waters. Our soundings point to a continuous ridge, but more close investigations are however necessary, as breaks may possibly be found in the ridge off the deeper fjords.

In Fig. 1 is given a rough sketch of the coast of East Greenland south of Angmagssalik showing the route of the *Dana*. Fig. 2 shows the bottom relief on one of the sections (marked with a cross in Fig. 1); the other sections show, however, on the whole, much the same conditions. It will be seen that the submarine ridge is about 230 metres below the surface in the section in Fig. 2 and it is about 20 miles off the coast line. Farther north the ridge is more than 20 miles from the coast-line (going up to about 30 miles). The greatest depth measured inside the ridge where the depths are rather variable is about 600 metres; outside the ridge the depth increases very rapidly to more than 1,500 metres. On the ridge itself we obtained depths of 170–240 metres, most often 200–240 metres. In the trough formed by the ridge along the coast we have the ice-cold East Greenland Current; outside or over the ridge we met with the warm Atlantic water with temperatures up to 8° C.; between these water masses we have mixed water layers.

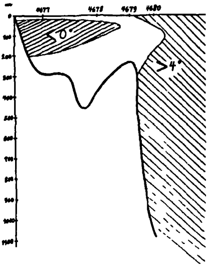

FIG. 2. Section at X in Fig. 1, showing submarine ridge and temperature of the bodies of water on each side of it.

During recent years the late Prof. Johs. Schmidt succeeded in showing that there is an interchange of the stock of cod in Icelandic and Greenlandic waters. In 1933 the migrations of cod from West Greenland to Iceland were even greater than in preceding years in which investigations were undertaken. Probably it will be possible in the future to show that the cod migrating from one of the areas mentioned to the other follow the ridge in question, where 'cod temperatures' will probably prevail during most years. We shall then be able to understand how the cod find the path from West Greenland to Iceland and vice versa.

Å. VEDEL TÅNING.

Marine Biological Laboratory,
Copenhagen.
Jan. 12.

Constitution of Dysprosium, Holmium, Erbium, Thulium, Ytterbium and Lutecium

CONTINUING the examination of the rare earth elements by the method of anode rays as already reported[1], I have now been able to complete the analyses of the group

Dysprosium (66) gave poor spectra but sufficient to indicate that it consists of mass numbers 161, 162, 163, 164 not differing much in relative abundance.

Holmium (67) is quite definitely simple 165

Erbium is not so complex as it was at first supposed to be. The early samples used were evidently contaminated A pure sample gave three strong lines, 166, 167, 168 and a weak fourth 170

Thulium (69) is simple 169

Ytterbium (70) appears to contain mass numbers 171, 172, 173, 174, 176, of which 174 is the strongest

Lutecium (71) is simple 175

It will be seen that these six elements fill all the numbers from 161 to 176 and show no isobares.

A full account of this work will be published in due course with estimates of relative abundance and the atomic weights so deduced It is already evident that the international values for several of the rare earths are in need of revision That of holmium (163 5) is particularly bad

F W. ASTON

Cavendish Laboratory,
Cambridge
Feb 17

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[1] NATURE, 132, 930, Dec 16, 1933

Value of e/m

SIR ARTHUR EDDINGTON[1] has developed theories according to which

$$hc/2\pi e^2 = 137,$$

and the ratio of the mass of the proton to that of the electron is

$$M/m = 1847\ 6$$

I have shown[2] that these theories and most experimental data are in extremely good mutual agreement The only experimental evidence against them[3] is that given by recent determinations of the specific electronic charge[4], which may be summarised as

$$e/m = (1{\cdot}759 \pm 0\ 000_5) \times 10^7 \text{ E.M U.}$$

These measurements disagree with the value deduced[5] from $M/m = 1847\ 6$, namely,

$$e/m = (1\ 77031 \pm 0\ 00014) \times 10^7.$$

However, Sir Arthur Eddington pointed out[6] that his work and the discovery of the neutron made it seem likely that the equations used in deducing the spectroscopic estimates of e/m are in error.

I am writing to suggest that some (or possibly all) of the experimental determinations of e/m are really measurements of

$$\frac{136}{137}(1{\cdot}77031 \pm 0{\cdot}00014) \times 10^7;$$

that is to say, of $(1{\cdot}757{,}4 \pm 0{\cdot}000{,}14) \times 10^7$ E M U. This is in reasonable accord with the $1\ 759 \pm 0\ 000_5$ recently obtained experimentally (being smaller than some and larger than other of the experimental results)

If this supposition proves to be correct, the only evidence against Sir Arthur's 137 and 1847 6 would vanish.

W N BOND

Department of Physics,
University of Reading
Feb 13

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[1] Eddington, *Proc. Roy Soc*, A, 143, 327, and earlier papers

[2] Bond, *Proc Phys Soc*, 44, 374, 1932

[3] Birge, *Phys Rev*, 40, 319, 1932

[4] Dunnington, *Phys Rev*, 43, 404, 1933 Kretschmar, *Phys Rev*, 43, 418, 1933 Robinson, Andrews and Irons, *Proc Roy Soc*, A, 143, 48, 1933

[5] Birge, loc cit

[6] Bond, *Phys Rev*, 41, 368, 1932

Reaction of Heavy Water with Metallic Sodium

MESSRS C O DAVIS and H L Johnston report[1] that when metallic sodium is dissolved in heavy water, the diplogen content of the evolved hydrogen is reduced and the diplogen content of the solution correspondingly increased We wish to put forward the results of similar experiments, which have been carried out in a somewhat different way and seem to lead to a more precise interpretation of this reaction.

Metallic sodium was introduced into an evacuated glass bulb by electrolysis, and heavy water was then distilled into the vessel In two experiments an excess of water was taken, in two other runs there was an excess of sodium metal. In all experiments the quantity of hydrogen evolved was found to be 0 5 mol. per mol of decomposed water. The original water contained 1·81 parts of diplogen to 100 parts of hydrogen + diplogen

1. Water excess, room temp.	0 96	per cent D in H_2+HD formed
2. Sodium ,, ,,	0 99	
3 ,, ,, $-10°$ C	1 01	
4. Water excess, room temp.	1 03	

These values are in agreement with the 'separation factor' reported by Davis and Johnston

Since in presence of an excess of sodium the whole of the water was decomposed, the shift in the diplogen content of the hydrogen produced cannot be accounted for by a difference in the rate of reaction of H_2O and HDO with sodium. The case is therefore different from the shift observed in the reaction between iron and water[2]

The correct description of the phenomenon appears to be this · Decomposition of HDO by metallic sodium can lead alternatively to the formation of NaOH or NaOD, the latter alternative being preferred Or, putting it in a different way: when HDO comes into contact with sodium, the H-atom escapes with greater ease to combine with an H-atom released by a neighbouring pair of reacting particles ($Na+H_2O$), than does the D atom.

The greater ease of reaction of H as compared with D was predicted by Cremer and Polanyi[3] on account of: (1) the lower zero point energy of D-compounds[4], (2) the stronger leakage of H through energy barriers

In the present case of a single compound entering into two alternative reactions, the zero point energies of the initial states are identical. However, at the top of the activation barrier the two alternative reactions will show a difference in energy due to the different zero point energies of NaOD and NaOH. The former having the smaller zero point energy, the barrier will be lower, when NaOD is formed Formation of NaOD would therefore be preferred. An estimate of the effect of zero point energy makes it possible to assume that this is sufficient to account for the ratio of the two reaction rates actually found

Obviously the difference in the 'leakage' of the particles H and D would also lead to a preference of the observed reaction

We wish to express our thanks to Prof Polanyi for valuable discussions.

J HORIUTI
A L SZABO

The University,
Manchester
Feb 19

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[1] *J Amer Chem Soc*, 56, 492, Feb 1934

[2] Cremer and Polanyi, *Z phys Chem*, B, 19, 443, 1932

[3] Horiuti and Polanyi, NATURE, 132, 819, Nov 25, 1933

[4] This has also been independently recognised by H Eyring, *Proc Nat Acad Sci*, 19, 78, 1933

Production of Induced Radioactivity by High Velocity Protons

CURIE and Joliot[1] have reported that a number of new radioactive isotopes can be produced by the bombardment of various elements with α particles, these isotopes emitting positive electrons In particular, they showed that boron when bombarded by α-particles was transformed to the isotope N^{13}, radio-nitrogen, this isotope having a half life of 14 minutes They suggested that the isotope might be produced by the bombardment of carbon with heavy hydrogen, the product, N^{14}, disintegrating with the emission of a neutron to radio-nitrogen

We have bombarded a target of Acheson graphite with *protons* of 600 k v. energy and have used a Geiger counter to search for any radiations produced after the bombardment ceased After bombardment for 15 minutes with a current of about 10 microamperes of protons, the target was removed from the apparatus and placed against the Geiger counter We then observed about 200 counts per minute, being about forty times the natural effect The number of counts decayed exponentially with time, having a half life of $10\ 5 \pm 0\ 5$ minutes

We then carried out an experiment similar to that performed by Becquerel, in which the source was placed on one side of a 9 mm thick lead plate with the counter on the opposite side, the whole being placed in a magnetic field, so that any electron emitted could only reach the counter by applying a field of appropriate sign and magnitude We found that when the field was such that positive electrons could reach the counter, the number of counts increased by a factor of 3, when the field was in the reverse direction no definite increase was observed We conclude, therefore, that the radiations consist in part at least of positive particles

We have also taken about 250 Wilson chamber photographs in a field of 2,000 gauss, placing the activated source against the outside of the chamber wall, which was about 3 mm. thick Under these conditions, we observed only two electrons of positive curvature which could possibly have come from the source, these electrons having energies of the order of 500 k v We observed, on the other hand, 48 tracks of Compton electrons starting in the gas, having energies ranging from 100 k v to 500 k v., suggesting the emission of γ-rays of energy between 500 k.v and 1 million volts These γ-rays may result from the annihilation of the positive electrons, presumably in the glass wall of the chamber The deflection experiments, whilst not at present precise, tend to confirm that few of the positive electrons would have sufficient energy to penetrate the glass walls Further experiments will, therefore, be carried out with the source inside the chamber *

The observations suggest that the unstable isotope N^{13} is produced by the addition of a proton to C^{12} The difference between the half life observed and that reported by Curie and Joliot may be due to the formation of N^{13} in a different excited state

No marked increase in the number of counts was observed when a mixed beam of heavy hydrogen ions and protons was substituted for the proton beam

We are very much indebted to Dr K T Bainbridge, who supplied the Geiger counter with which the observations were made

J D COCKCROFT
C W GILBERT
E T S WALTON

Cavendish Laboratory,
Cambridge
Feb 24

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* February 27 Experiments carried out with a counter having a mica window of small stopping power gave a great increase in the number of counts owing to the positive electrons now entering the counter The absorption curve of the positive electrons is similar to that of negative electrons of 800 k v energy

[1] *Comptes rendus*, 198, 254, 1934

A Perturbation in the Spectrum of Se II

WHEN the analysis of the spectrum of Se II has been completed, it is observed that the quartet

$$\begin{aligned} & & & \nu\ (\text{int}) \\ 4p\ {}^4S_{1\,1/2} & - 5s\ {}^4P_{1/2} & = & \ 95270\ (10) \\ & - 5s\ {}^4P_{1\,1/2} & - & \ 96753\ (10) \\ & - 5s\ {}^4P_{2\,1/2} & - & \ 98676\ \ (4) \end{aligned}$$

due to the fundamental transition $4p \rightarrow 5s$ exhibits abnormal relative intensities of its components The intensity ratio of these lines, according to Burger and Dorgelo's rule, should be 2 4 6, the line $S_{1\,1/2}-P_{2\,1/2}$ being thus the brightest and the most easily excitable of the group, whereas in Se II, it is extremely faint under all the variety of experimental conditions of excitation in which the group has been photographed The corresponding quartets in other similar spectra, hitherto known, do not show this anomalous feature.

In Se II this must obviously be a perturbation in intensity arising from the mutual interaction of adjacent spectral terms ; for our analysis has revealed a clear interpenetration of the levels due to the *5s* and *4d* configurations, while in the lighter elements there is a somewhat large separation between these two groups of energy states

Excepting this intensity anomaly, the other characteristics of Se II are found to be generally analogous to those of As I or S II. Full details of this scheme will be published shortly.

K R. RAO.
S. GOPALA KRISHNAMURTI.

Science College,
Andhra University,
Waltair Dec 18

Feeding Mechanism of the Fairy Shrimp

In a recent paper[1] Mr. Lowndes has put forward a new view as to the filtratory feeding mechanism of the fairy shrimp, *Chirocephalus diaphanus*. Hitherto all workers (Storch[2], Lundblad[3], Naumann[4], Borradaile[5], Wagler[6] and Cannon[7]) have agreed that the long setæ on the edges of the basal endites of the trunk limbs constitute the filter, or at least a retaining wall by which particles are abstracted from a current of water.

Mr. Lowndes maintains that water enters the inter-limb spaces between successive limbs, past the endopodites and exite series, which hitherto have been accepted as valves preventing the inflow of water, and that some of this water is then forced into the deep food groove running along the mid-ventral line of the body. Here it is filtered by patches of setules on the food groove walls, which he calls the "filter processes".

In a recent paper[8] I described and figured these 'filter processes' in the three orders of Branchiopoda in which they occur, and showed that they are comb setules which comb the residue off the filter setæ on the basal endites. That the latter are actually filters is shown by the two facts: (1) the water current can be seen to pass through them from the mid-ventral space, as I described in 1928, and (2) they have the typical structure of filter setæ. In all those numerous forms where, either experimentally or by the position of the food in sections of the fixed animal, it can be shown that a limb acts as a filter, the same type of seta is found (Cannon[8], p. 275) and this is the type found in *Chirocephalus*.

In all filtratory setæ the ultimate meshes of the filter are formed by fine setules regularly arranged on the edges of the setæ. If further evidence is required beyond direct observations that the water current passes from the mid-ventral space through the filters, it is found in the position of its setules – they always face the direction from which water to be filtered comes, and in *Chirocephalus* they all face the median plane.

The only point previously on which workers have been unable to agree is as to the mechanism by which the filtered food is transported to the mouth. Storch[2] (p. 387) maintains that it is swept forwards by the action of the most proximal setæ on the basal endites, while I maintained[7] (p. 811) that there is a definite oral current in the food groove. This is the only current which cannot be observed directly, and so I demonstrated it experimentally. I injected a coloured solution so as to fill completely one of the inter-limb spaces of a captive *Chirocephalus*, and was then able to show that at the end of the backstroke of the limb forming the anterior wall of this space, a spurt of the solution was forced along the food groove. Mr. Lowndes has now repeated my experiment and confirmed my results.

H. GRAHAM CANNON

The University,
Manchester.
Feb. 12.

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[1] Lowndes, *Proc. Zool. Soc. Lond.*, 1093; 1933.
[2] Storch, *Intern. Rev. Hydrobiol.*, 12, 369; 1925.
[3] Lundblad, *Arkiv Zoolog.*, 13, 16; 1920.
[4] Naumann, *Act. Univ. Lund*, 17, 4; 1921.
[5] Borradaile, "The Invertebrata", Cambridge, p. 320; 1932.
[6] Wagler, Kukenthal's "Handbuch der Zoologie", 1926, p. 366.
[7] Cannon, *Trans. Roy. Soc. Edin.*, 55, 807; 1928.
[8] Cannon, *Phil. Trans. Roy. Soc. Lond.*, 222, 267; 1933.

'Mimicry' among Insects

There has just come to hand (*Entomologica Americana*, 13, No. 3, published (as stated on cover) Nov. 29, 1933, but dated on every page December 1932) a most admirable review of the Polybiine wasps of the Nearctic region, by Dr. J. Bequaert. Unlike many taxonomic papers, it treats not only of the structures of the insects, but also, at considerable length, of their biology, everything being set forth in the most interesting way. There is a good account of the cases of 'mimicry' involving these wasps. Thus the wasps of the genus *Nectarina*, in the neotropical region, belong to an assemblage of diverse insects of similar appearance, of which no less than twenty-eight are cited. Dr. Bequaert recognises the objections to the term mimicry as applied to these cases, and proposes to speak of homoeomorphy and homoeochromy instead, these terms merely referring to the observed facts, without suggesting any explanation. This seems to be an advantage, though perhaps the shorter words isomorphy and isochromy would be preferable.

In discussing the probable meaning of these resemblances, as related to natural selection, I think Dr. Bequaert takes too narrow a view. Thus he refers to the American *Pachodynerus nasidens*, which has been accidentally introduced into the Hawaiian Islands, where it has become extremely abundant. Now the Hawaiian Eumenid wasps have a totally different appearance, and so, he argues, *P. nasidens*, removed from the protection of its mimetic group, ought, according to the current theory, to be severely handicapped. This argument I think has no validity, in view of the great difference in the vertebrate fauna. *P. nasidens*, along the Hawaiian coasts, is not only without the natural enemies it left in tropical America, but also is relatively free from enemies of any kind, as will be readily appreciated by anyone who has travelled in both regions.

There is, however, another aspect of these matters which is not generally considered. Insects are extremely prolific, and the balance of Nature, under normal conditions, provides for the destruction of by far the greater part of each generation before the period of reproduction. This destruction is necessary for the insect itself, in order to avoid over-population and resulting starvation. Hence the normal survival rate, according to the species, may be only ten per cent, or five per cent, or even less than one per cent of the offspring hatched from the egg. It is astonishing that, working on such a narrow margin, insects in general survive as well as they do. I recall some observations on Coccidæ (scale insects) made in New Mexico many years ago. Certain species occur on the mesquite and other shrubs which exist in great abundance over many thousands of square miles of country. Yet the coccids are only found in isolated patches here and there. They are destroyed by their natural enemies, but the young larvæ can be blown by the wind or carried on the feet of birds, and so start new colonies which flourish until discovered by predators and parasites. This game of hide-and-seek doubtless results in frequent local extermination, but the species are sufficiently widespread to survive in parts of their range, and so continue indefinitely.

We may suppose, then, that neither 'mimicry' nor any other mode of protection prevents the destruction of the larger part of each generation of insects; and such prevention, were it possible, would result, not in stable conditions, but in over-production and disaster But during any lengthy period, the species of insects will show fluctuation in the number of surviving individuals, and must from time to time come very near to extinction. Indeed, very many do become extinct, as we can infer from a study of the fossil records During these recurring 'hard times', slight advantages or disadvantages are of critical importance and may decide between survival and extinction But at other times of greater prosperity, they seem to be of little consequence If a 'critical' period occurred once in a thousand years, it would suffice for all the purposes of the theory

Another important consideration is the frequency of parallel and 'convergent' variation; the continual recurrence of similar structures, patterns and colours in different genera and species These phenomena indicate the existence of deep seated tendencies, which find expression without any reference to immediate utility In this way it often happens that diverse insects, even in different localities, come to look alike, and if 'mimicry' is promoted by natural selection, these resemblances are the raw material on which it works

T. D A. COCKERELL.

University of Colorado,
Boulder, Colorado
Dec 8.

Bilateral Gynandromorphism in Feathers

IN recent publications Lillie and Juhn[1], Domm, Gustavson, and Juhn[2], and Lillie[3], have suggested an explanation of the bilateral gynandromorphism of certain individual feathers. This explanation is based upon the idea that susceptibility to female hormone depends upon growth rate, being greatest for slow-growing and least for quick-growing feather tissue. These authors further describe the formation of the rachis by concrescence The rachis thus has a double origin, and its two sides were once the two halves of the collar. This description differs widely from the accounts of Strong[4,5] and of Davies[6].

Now it may be remarked that past growth rates can only be measured by the relation of the size of present to past structures, and that present growth rates cannot be measured at all It would seem, therefore, that the suggestion that in a bilaterally gynandromorphic feather the growth rates on the two sides of the collar were so different that, on the theory advanced by Lillie and his collaborators, female hormone could act on one side and not on the other, can only find a foundation in observation in one of two sets of circumstances. Either (a) the barbs on the two sides must be of different lengths, and the rachis curved, since one side of it has grown faster than the other; or (b) the feather germ must have an asymmetry of just such a kind and degree as to compensate for the difference in growth rate and give a straight feather. This asymmetry might be in fact a displacement of the ventral growing point from its theoretical position diametrically opposite the forming rachis; then the more rapidly growing side could get carried out of the region of growth so much sooner than the more slowly growing side, having less distance to travel, as to be the same size or even smaller.

The condition (a) is certainly not fulfilled in fact. The bilaterally gynandromorphic feathers shown in Figs. 51 and 52 by Lillie and Juhn[1] are straight, as are those figured by Cook, Dodds and Greenwood[7]. The retrices of Bond's pheasant[8] have a curvature which is not in constant relationship to their sexual dimorphism. There remains condition (b). Lillie and Juhn[1] figure an asymmetrical germ (Fig. 8), which gives rise to a feather symmetrical in shape, so that by their account its growth must have been different on the two sides. The relationship of colour to growth rate is, however, not shown by this example as the feather is also symmetrical in colour.

While the work of Lillie and Juhn and the other authors referred to is clearly of the very greatest interest and importance, it seems, in the light of the foregoing remarks, that the concept of the formation of the rachis by concrescence may lead to difficulties in the interpretation of sexually dimorphic colours which might be avoided by the adoption of other accounts of feather development, and that growth rate may not play quite the part assigned to it in determining the susceptibility to female hormone of the parts of the feather.

It is hoped soon to undertake work in this Department involving in particular an analysis of the relationship of asymmetry in the germ to asymmetry in the feather, and to review in the light of any evidence gained the physiological principles concerned, whether they be of growth rate, or of differentiation rate, or of a kind not yet apparent.

PAUL G 'ESPINASSE

Department of Zoology
and Oceanography,
University College,
Hull
Jan 22.

[1] *Physiol. Zool*, 5, No 1, 1932

[2] Section on plumage tests in birds in "Sex and Internal Secretions". Edited by Allen (Williams and Wilkins, 1932)

[3] *Science*, 74, 387, 1931

[4] *Bull Mus Comp Zool. Harvard*, 40, 147, 1902

[5] *Biol Bull*, 3, 289, 1902.

[6] *Morphologische Jahrbuche*, 15, 560, 1899

[7] *Proc Roy Soc*, B, 788, 286, 1934

[8] *J Genetics*, 3, 205, 1913

Designation of the Positive Electron

I HAVE been hoping that, following Lord Rutherford's proposal of a name for the heavy isotope of hydrogen, someone would suggest a more satisfactory word than 'positron' for the positive electron. Since, however, no better qualified reformer has appeared, may I raise the question before it is too late? 'Positron' is ugly; it offends literary purists by its hybrid character, and it not only bears no relation to the established name of the associated particle, the electron, but even suggests that that particle should be called the 'negatron', which fortunately it is not.

In order to balance destructive by constructive criticism, I venture to propose the name 'oreston' for the newcomer. The word is euphonious, pure Greek, and since, in one of the most beautiful of Greek stories, Orestes and Elektra were brother and sister, it implies an appropriate relation between the two particles The name found favour among many physicists in Pasadena where Anderson first obtained evidence of the particle, when I mentioned it there last year. I do not propose, however, further to urge its claims, the purpose of this letter being mainly to cleanse the language of 'positron', and only incidentally to nominate a substitute.

HERBERT DINGLE.

Imperial College,
South Kensington, S W.7.
Feb. 12.

Active Nitrogen and the Auroral Spectrum

IN my letter in a recent number of NATURE[1] I described an afterglow in nitrogen in which the first negative bands of N_2 were present, and in which the excitation of the first positive bands was different from that hitherto observed in nitrogen afterglows. At the time the letter was written, no photograph of the afterglow intense enough to print had been obtained. Fig. 1 shows a photograph of the spectrum of the afterglow which has been obtained since then, and it is to be noted that with the exception of the green auroral line, the afterglow spectrum is remarkably like the auroral spectrum. In my first letter it was stated that the second positive bands were completely missing from the afterglow, and that was true of the plate which was described in that letter, but a trace of the second positive group can be very easily seen on the present plate and they have been obtained with considerable intensity on a plate taken on a small quartz Hilger spectrograph. The arrows on Fig. 1 point to first positive band sequences which originate on $V' = 16, 17, 18$, etc., and it is seen that these sequences are present on the afterglow plates also.

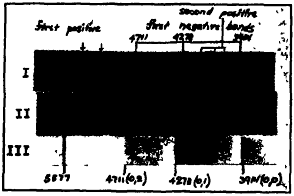

FIG. 1. I, Direct discharge (panchromatic plate); II, afterglow (Eastman astronomical green plate); III, aurora borealis (dispersion different from I and II).

Further experiments are now in progress in order to obtain better pictures of the first positive bands in the green, red and the photographic infra-red.

JOSEPH KAPLAN

University of California at Los Angeles
Jan. 12.

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[1] Kaplan, NATURE, 132, 1002, Dec. 30, 1933.

Age of Sub-Crag Implements

MR. J. REID MOIR has recently directed attention to an interesting series of worked flints found beneath the Red Crag, exhibited at present in the British Museum[1]. Adhering to one of these flints is some ferruginous sandy material which Mr. Moir regards as Diestian, since it resembles the sandstone of which the well-known Suffolk Boxstones are composed. Thanks to the courtesy of Mr. Reginald Smith, I have had an opportunity of examining this specimen. The encrusting material is an iron-cemented sand which appears to me to bear a stronger resemblance to Red Crag sand than to Boxstone material. The quantity of sand is too small to permit mineralogical analysis; moreover, such a process would destroy the evidence. Even if it were proved to be Boxstone detritus, the possibility of its having been re-deposited in Red Crag times would have to be seriously considered.

Mr. Moir bases interesting speculations on the possibility of the rostro-carinate implement in question being pre-Diestian, that is, pre-Pliocene. In this connexion, it is important to bear in mind that the British representatives of the Continental Diestian deposits are the Lenham Beds (Early Pliocene) of Kent and Sussex, and not the Boxstones of Suffolk, as Mr. Moir states. Our knowledge of the fauna of the Lenham Beds has been increased by discoveries made during the last few years, and recent investigations have served to emphasise the greater age of the Boxstone fauna. The latter is regarded by many geologists as Miocene; in fact, some of the mollusca are apparently related to Upper Oligocene forms. Mr. Moir's arguments would therefore imply that the maker of the rostro-carinate implement lived in times not later than the Miocene.

P. G. H. BOSWELL

Imperial College of Science
and Technology,
South Kensington,
London, S.W.7.
Feb. 13.

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[1] NATURE, 133, 64, Jan. 13, 1934.

Ernst Haeckel

MANY scientists will have read with keen interest Prof. MacBride's delightful sketch of Haeckel's work in NATURE of February 10. As he points out, Haeckel's career belongs to the heroic stage of the history of the theory of evolution; certainly few men have been subjected to greater obloquy for promulgating that or any other doctrine. When his "General Morphology" appeared, it was met with "icy silence"—a reception which the impetuous and combative Haeckel could not tolerate. He would have preferred hostile criticism, rather than indifference; and to this indifference on the part of his fellow-scientists can be traced the commencement of that series of popular works on evolution which were met, not with "icy silence", but with fiery blasts from scientists and laymen alike.

At one period of the controversy, Haeckel felt that his presence at Jena was jeopardising the good name of his beloved university, so he offered to resign his chair; but the head of the governing body replied: "My dear Haeckel, you are still young, and you will yet come to have more mature views of life. After all, you will do less harm here than elsewhere, so you had better stop here." In point of fact, Jena never forsook Haeckel and Haeckel never forsook Jena, despite the flattering offers he received from the Universities of Vienna, Würzburg, Bonn and Strasbourg; and he died there, not in 1914 as mentioned by Prof. MacBride, but on August 8, 1919. An obituary notice appeared in NATURE of August 21, 1919.

W. H. BRINDLEY

11, Millmoor Terrace,
Glossop, Derbyshire.
Feb. 9.

I AM sorry that I made a slip in giving the date of Haeckel's death. I thank Dr. Brindley for correcting me.

E. W. M.

Research Items

Moravian Racial Types. Prof. V. Suk contributes remarks on the value of selective study in the anthropometric investigation of a population as a means of distinguishing ancestral types, to a study of groups of people in Moravian Wallachia by Dr. K. Augusta which has been published by the Faculty of Sciences of the Masaryk University. Two groups were investigated in a population which has long lived in isolation in conditions which do not invite immigration. The traditional mode of life is agriculture, woodcraft, or herding pursued in woodland clearings. The people here specifically called "Valaques", according to recent theory based on linguistic evidence, are partly of Slovak, partly of Rumanian origin. The principal results of Dr. Augusta's anthropometric examination go to show that they are of mixed origin. Taking the two groups together, they show a medium stature (165·9 cm. and 167·1 cm.), they are brachycephalic (85·2 and 85·8), while the mean circumference of the head increases proportionately with increase in growth of stature. The face is mesoprosopic and the nose lepto- to mesorrhine (69·7 and 70). In pigmentation the eyes most frequently are grey or greenish, while the hair is light brown, next in frequency coming dark brown, and then blond, which, however, is rare, showing only 1·0 and 2·7 per cent. 'Pure' types are rare and the most common by far is the 'mixed light brown'. In the valley of *Dinotitza*, where the selective method of Prof. Suk was employed and not the statistical method on which the figures above were based, a considerable percentage was found of a type differing from the remainder of the population, darker, taller and more pronouncedly brachycephalic, showing all the marks of a Dinaric origin. This confirms the view that the population of this part of Wallachia is of a different somatic origin from the rest of the population. Its derivation must be sought in Rumania.

The Australian Oyster. T. C. Roughley in his paper, "The Life History of the Australian Oyster, *Ostrea commercialis*" (*Proc. Linn. Soc. New South Wales*, 58, Parts 3 4, 1933), studies the Australian edible oyster of commerce in great detail. This species appears to be confined to the Australian coast, its range extending from the far North Queensland coast to so far south as Wingan Inlet in Victoria. It thrives best in estuaries fed by much fresh water. Spawning always takes place on the chief bed studied (Port Macquarie) during spring tides when two or three hours on the ebb and often when a heavy sea is running outside, the temperature being usually 72°–76° F. In other places the oysters appear to spawn partially at intervals, and spawning proceeds daily or almost daily during the whole of the spawning period over five months. There is, however, great irregularity in the spawning of these New South Wales oysters, the reason probably being that the bulk of the oysters are grown in the tidal zone where temperature fluctuations, varying from cold water to hot sun in the course of a few hours, are enormous. A sex change is indicated in this species by the fact that practically all, if not all, young oysters spawn for the first time as males. Nine oysters were found (1–3 years) which contained both ova and sperms in the gonad. The determination of sex in this oyster does not appear to be governed by the amount of food available.

Feeding of the Fairy Shrimp. A. G. Lowndes has recently recorded observations on the feeding mechanism of the fairy shrimp, *Chirocephalus diaphanus* (*Proc. Zool. Soc.*, Lond., Part 4, 1933). By keeping the animal in a fixed position while causing a current of water to flow past it at the rate of two feet per minute (the normal rate of swimming of the shrimp), the movements of the appendages under approximately normal conditions can be observed. The author has also employed the polygraphic process, that is, taking photographs about 20 per second, by means of which the movements of the limbs can be recorded. He states that the commonly accepted view that *Chirocephalus* feeds chiefly on suspended particles is incorrect; its chief food consists of detritus. The larger food particles, for example, filamentous algæ, leaves of mosses, etc., are not sucked into the median ventral groove between the appendages, but are pushed in by the endites and pushed towards the mouth by the spines and setæ on the basal endites or gnathobases, which may act in apposition. Suspended particles drawn into the median groove cannot settle there by reason of the increase in the rate of flow as the groove narrows, nor is it likely they can be caught by a secretion of mucus. The movement of the limbs is irregular and only roughly metachronial. Any account of feeding which demands precise co-ordination of the limbs is untenable. The exopodite, regarded as the chief swimming limb, functions as a propeller and not as a paddle. Sars's view, that the primary function of the phyllopod post-oral limb is respiratory, is upheld (see also p. 329 of this issue).

Fungi Imperfecti. Referring to a notice in NATURE of December 16, p. 936, of Mr. J. Ramsbottom's presidential address to the Quekett Microscopical Club, in which the suggestion was made that many of the Fungi Imperfecti are mutants from heterothallic strains, Mr. H. A. Dade, of the Gold Coast Department of Agriculture, in a letter to the Editor, describes some unpublished work of his which supports the suggestion. In 1928 he showed that the common tropical *Thielavia paradoxa* is the conidial stage of a *Ceratostomella*, *C. paradoxa*, which is heterothallic. So far, the perfect stage has been found only on the Gold Coast. After the publication of his account, he received numerous cultures from other countries which differed much in cultural characters though not sufficiently to merit specific distinction. Some few when mated with the original strains formed perithecia, others did not. Two vigorous Ceylon strains formed perithecia when crossed with the (+) and (−) Gold Coast strains, but not when mated together, the loss of this power presumably being due to mutation.

Practical Methods of Soil Heating. A good deal of attention has recently been focused on the question as to whether raising the soil temperature in glass-houses by artificial means would be a commercial proposition in Great Britain as it has been in Scandinavia. Investigations on the matter have been carried out at Cheshunt Research Station and the results recently described by Dr. W. F. Bewley (*J. Min. Agric.*, 40, 1047). Cables consuming 1 kilowatt per hour at 240 volts were laid 16 in. below the surface of the soil. Heat was applied from 10 p m until 6 a m for the first twelve weeks after planting In the case of tomatoes, those grown on the heated soil showed more rapid growth, cleaner roots, earlier flowering and quicker fruit maturation than the plants on the untreated soil, and in 1929 the total crop was 20 7 per cent higher in the former case. Similar promising results were obtained with cucumbers The chief problem, however, was cost The cables, which are expensive, deteriorate rapidly, and further, the annual renewal of cucumber beds necessitates relaying the wires each season Twisted strands of galvanised steel wire (14 s w G), however, showed no corrosion after three seasons and proved considerably cheaper The price of heating, even at ¼d per unit, also is high, since about 5 watts per square foot are required to raise the temperature 6° F. (from 66° to 72) Another and cheaper method of soil heating which gave promising results was that derived from an underground extension of the ordinary hot-water pipe system The temperatures found to give good results were 70°–75° F Further advice on the subject can be obtained on application to the Director, Experimental and Research Station, Cheshunt Herts

Colour Photometry The rapid extension of the use of coloured luminous electric discharge tubes for lighting and advertising purposes has raised into prominence the question of how best to measure the candle powers of coloured lights, and Mr. H Buckley and his colleagues at the National Physical Laboratory have tested the methods available The results at which they have arrived were communicated by Mr Buckley to the Illuminating Engineering Society in a paper read before the Society on February 20 The original method of comparing the brightness of two sources of different colours is both difficult and unreliable, but the newer 'flicker' method is easy to carry out and reliable The 'calculation' method, which depends on the determination of the energy distribution of the light source and on the effect which each colour produces on the eye, while it gives accurate results, is tedious and requires skilled work with a spectrophotometer Mr Buckley advocates the use of coloured screens the absorption of which throughout the spectrum is observed by the spectrophotometer and which when placed between a standard light and a photometer of either of the above types will give an approximate match with the coloured light to be measured A small field of view seems an advantage

Acid Catalysis in Non-Aqueous Solvents. A number of reactions are catalysed in watery solution by acids irrespective of the precise nature of the latter R P. Bell (*Proc Roy Soc.*, A, Jan) has studied the catalytic effect of a number of acids in solution in chlorobenzene, benzene and some other solvents. The catalysis in such solvents must be due to the acid molecule and not to the other products formed in presence of a dissociating solvent like water The reaction studied was the re-arrangement of *N* bromoacetanilide to form *p*-bromoacetanilide, and the reaction was followed by using the liberation of iodine from acid potassium iodide by the *N* bromoacetanilide It was found that the catalytic power increased in the same order as the strength of the acids, as measured by their dissociation constants in water. Picric acid occupies an anomalous position, possibly because of tautomerism in the picrate ion. Quantitatively, the catalytic power increases less rapidly than the dissociation constant in water, the values being connected by a 0 3 power law Very similar results were obtained from some less accurate measurements in benzene solution and from a few experiments in ethyl nitrate and ethylene chloride The rates of reaction in chlorobenzene are 10^4 10^5 times less than those calculated on the assumption that every collision is effective that takes place between a reactant molecule and a catalyst molecule with the proper energy of activation

Action of Solvents on Coal. Of the methods employed for studying the constitution of coal, none has been more popular than the use of solvents to separate constituents of different character The range of solvents used by different workers is large and the report on "The Action of Solvents on Coal" (Fuel Research Board Technical Paper No 37, H M. Stationery Office, 4*s* 6*d* net) containing a critical survey of work in this new field, supplemented by experimental study, will be useful to all engaged in this branch Unfortunately, the selective action of solvents is never clear-cut, and the character of coal shows infinite variety, leaving opportunity for great diversity of findings Even since the writing of the book, new complications have appeared in the discovery that some solvents can, by reaction or condensation, produce resinous matter which has at times been attributed to the coal Moreover, it has been shown that the portion capable of extraction can be considerably increased if the coal be first reduced to dimensions of the order of one micron

Reinforced Concrete Structures. Steel, with its great tensional, and concrete with its great compressive, strength, possessing similar coefficients of expansion, seem to have been intended for combination in structures Rules controlling the use of any form of construction must necessarily be framed on conservative lines in the absence of scientific data, and when wide application precedes detailed research caution is the more required, but experience gained shows that without impairing safety greater economy in the employment of these materials as re-inforced concrete is possible To meet this national need and the requirements of the London County Council, which is revising the London Building Act, a committee was set up by the Department of Scientific and Industrial Research under the chairmanship of Sir George Humphreys to consider improvements in the regulations for re-inforced concrete work, and this committee with the information on the better and more scientifically prepared materials now obtainable before it, has produced a code of practice based on present-day knowledge which will admit of considerable economies being effected An entirely new feature of these regulations is the permission of three grades of work allowing greater stresses, or, in effect, less material to meet the required stresses, where more care and skill is given as adjudged by the tests required on samples made as the work proceeds. The code defines the materials and details of construction allowed and gives the strengths to be shown by tests when called for Though actually only applicable to the area administered by the L.C.C., it is expected that the code will form a standard for use throughout the country. During the work of the committee, the investigation at the Building Research Station under Dr Stradling has proved a valuable asset.

Palestinian Prehistory

THE selection of archæological finds from the caves of the Wady al-Mugharet at the foot of Mt. Carmel, Palestine, now exhibited at the British Museum (see NATURE, Feb. 3, p. 169), repays careful inspection. By affording a comprehensive view of the results achieved since 1929 by the Joint Expedition of the British School of Archæology in Jerusalem and the American School of Prehistoric Research under the field direction of Miss D. A. E. Garrod, the exhibit fully confirms previous conclusions, based on the periodical reports, as to the importance of the excavations in these caves, not only for the prehistoric archæology of Palestine, but also for prehistory in general. The discovery of so large a number of skeletons of man of Neanderthaloid type, to whom Sir Arthur Keith would assign generic rank under the name of *Palæoanthropus Palestinensis*, and including the oldest known complete human skeletons, for which a geological dating as belonging to the Riss-Wurm interglaciation is given, would alone place these investigations in the first rank of scientific importance; but in addition they have brought to light a new civilisation and a new race, the Natufian, of late palæolithic or mesolithic age, in which remarkable features of racial character and culture open up suggestive lines of thought in connexion with prehistoric custom and belief and racial distributions.

The exhibits include examples of the small flakes of the Tayacian, comparable with implements from La Micoque, the Upper Acheulean hand-axe, the leaf-shaped point of the Lower Aurignacian, hitherto known only from Africa, Middle Aurignacian scrapers, comparable with those of Western Europe, and characteristic scrapers and gravers from the Upper Aurignacian. The Natufian culture, of which the first evidence was found in the Wady el-Natufa, whence the name, is well represented, among the more striking features being the remarkably elaborate composite head-dresses of shells which were found on the human skeletal remains, and the evidences of the beginnings of agriculture in the form of sickle blades and hafts. The latter are further noteworthy as including among their number two hafts ornamented with carvings of animal heads. These with other gravings on bone or stone are the first and indeed the only known examples of the art of stone age man to be found in Palestine.

The human bones show evidence of cannibalism. Sir Arthur Keith, in reporting on the human remains, judged them to be unique in racial character, but found that certain features suggested affinities with pre-dynastic Egypt. The Natufian faunal remains include the true horse, the Persian fallow-deer and the spotted hyæna, now found only south of the Sahara. The frequent occurrence of remains of the gazelle point to a dry climate and open country, contrasting with conditions in late Mousterian times when the abundant remains of deer suggest a forested area with copious rainfall.

It will thus be seen that the exhibition covers the complete sequence of Palestinian prehistoric cultures from Acheulean to Bronze Age, the last named apparently following on immediately after the Natufian, or, in years, a period ranging from about 100,000 years ago to approximately 6000 B.C.

Future of Artificial Lighting

MR. C. W. Sully, president of the Illuminating Engineering Society, gave an interesting address at the British Industries Fair at Birmingham on February 22. He pointed out that although great progress has been made in illumination during the past fifty years, yet compared with some other applications of science, such as transport or telephony, its progress appears relatively slow. There is no occupation we can pursue and no recreation we can indulge, in which the eyes are concerned, that does not offer problems in lighting. Too frequently progress takes place in a succession of jerks. As an example, consider the headlights of a motor-car. With increased speed stronger lights were demanded. Concentrated beams, well directed towards the objects requiring illumination, served the driver of the car excellently. But it was soon found out that these beams were a menace to oncoming traffic and glare from headlights is still an outstanding problem.

New devices, new methods and new materials are constantly changing the technique of lighting and developing new sections of industry. The new methods of utilising gaseous tubes producing various colours, the new electric discharge lamps, the continually extending use of stainless steel for reflectors and the applications of the new synthetic plastic materials to lighting fittings may be mentioned. In some cases buildings like cinemas and theatres are expressly designed for use by artificial light. Natural lighting has become a minor matter and is in some cases entirely omitted. In the case of blocks of buildings in congested city areas, access of daylight is imperfect and so costly as to be almost prohibitive.

It is accordingly now being suggested that, in these circumstances, the effort to furnish natural lighting should be abandoned, and that efforts should be concentrated on the provision of adequate artificial lighting. The question arises as to whether there is anything inimical to health in this procedure. This is a question of moment to the lighting industry. The ever-increasing height of buildings and other developments will probably accentuate the need for artificial lighting at the lower levels.

The city of the future has been visualised as consisting mainly of immense flat-topped buildings, rising in terraces from the ground-level, the upper walks being reserved for pedestrians, who would be provided with connecting bridges crossing the roadways at intervals. Roadways at the ground level would be used exclusively for motor traffic. If this is the trend of development, then lighting at the lower levels would be mainly artificial. A suggestion has been made that football, athletic contests and other sports may, in the future, take place in vast covered stadiums where diffused artificial lighting, resembling light from the natural sky, would be attainable and where difficulties arising from our capricious weather would be largely eliminated.

Mr. Sully also discussed the lighting of schools and factories. In school buildings the natural and artificial lighting is often very defective In many recent factories excellent equipment is installed, but in some of the older buildings, antiquated and imperfect arrangements still persist Britain, almost alone amongst the civilised countries, has even now no specific requirement of adequate lighting in its Factory Act, although this step was advocated twenty years ago by a Departmental Committee

Mr Sully thinks that street lighting lags behind modern requirements. In a factory, five foot candles is regarded as essential for fine work According to the B S.I. specification, one per cent of this is given as the candle power sufficient for a moderately lighted street This only represents 1/10,000th of the average value of unrestricted daylight from an overcast sky No wonder the accident risk by night is greater than that by day The problem of public lighting is complicated by the fact that many roads now fulfil functions quite different from those for which their lighting was originally designed In Mr. Sully's opinion, the lighting of the King's highway is a national rather than a parochial duty The Ministry of Transport should assume a greater degree of responsibility for its illumination

Association of Technical Institutions

THE annual general meeting of the Association of Technical Institutions was held in the Drapers' Hall, London, on February 23–24 During the first session Mr. Will Spens, Master of Corpus Christi College, Cambridge, and newly-appointed chairman of the Board of Education's Consultative Committee, who was elected president of the Association for the year 1934, delivered his presidential address

At the outset, Mr. Spens suggested that he was unable to enter into a discussion how to enhance the value of technical education, since his knowledge of that, and of industry and commerce, was not very considerable However that may be, his address demonstrated the closeness and profundity of his knowledge of the field of education generally He insisted on the value of literary studies in teaching men to think he would not, therefore, have traditional academic education weakened, although he thought too much emphasis had been placed upon it. He pleaded for research in applied science, but stressed the need for inculcation of scientific *method* rather than the simple acquisition of scientific knowledge.

Among the papers read during the following sessions was one on "Education for Commerce from the Employer's Point of View" by Mr. F. Hickinbotham, of Birmingham He emphasised the point that commercial education lags behind other branches of technical education because of the fact that the need for specialised education for commerce arose later in commerce than in the sciences and skilled trades It is impossible, for example, to practice chemistry, pharmacy, engineering, etc, without a body of specialised knowledge, but many branches of commerce do not require this specialised knowledge. hence educational facilities have developed slowly The present need for systematic instruction, however, is occupying considerable attention Mr. Hickinbotham believed that the efforts which are being made to introduce commercial subjects into the secondary school curriculum were mistaken In the secondary school the pupil should receive a general education, and afterwards take a one- or two-year full-time course in a commercial college, where instruction given by teachers with commercial experience would be better than that given by teachers who acquire their knowledge merely from books One of the greatest needs of the world is to break down the barriers of nationalism and to promote a spirit of internationalism To this end the first essential is to know the language the other man is speaking Languages, therefore, should find an important place in all commercial courses

Mr Hickinbotham's paper had a special interest since the thought now being given to commercial education is a reflection of some of the wider anxieties of our civilisation. The science of production has developed swiftly and efficiently we have scarcely begun to understand the science of distribution Those responsible for technical education are alive to their responsibilities in this connexion. Evidence of this was submitted as the meeting proceeded, when a "Report on National Certificates in Commerce", prepared by a joint committee of the Associations of Technical Institutions, of Principals of Technical Institutions and of Teachers in Technical Institutions, was accepted While it does not yet seem possible to draw up a scheme for national certificates in commerce such as those applying to engineering, chemistry, etc, the report goes far to establish means by which it is hoped that national certificates in the full sense of the phrase may ultimately be available.

Dog Breeding for Show Points

"WE have bred dogs for all sorts of show points, but we have never considered whether our principles of breeding have been to the advantage of the dog itself We have thought only of our own profit." So concludes the editor of the *Countryman*, who asks whether or not our dog breeding principles so far, judged entirely from the dog's point of view, are not a bit 'low down' and, further, why should not some breeding now be done for intelligence? In a series of articles now appearing in this quarterly review, these questions are considered by a number of people Dr. Darling expends most of his space in proving to his own satisfaction that he is quite unable to decide as to what could be regarded as intelligence in the dog, and argues that in any event the experiment suggested has already been carried out with the working hill collie. But he agrees with the editor of the *Countryman* in stating that there can be no defence for many show points. The standard of the St Bernard is merely acromegaly, that of the bulldog achondroplasia; the toy dog is hyperthyroidic, and terriers microcephalic. Prof. L C. Dunn, of Columbia University, in a very well-written article, suggests that it is not intelligence that is being discussed but educability, and that this, possibly, is not associated with originality and critical judgment He then outlines the sort of experimental procedure which might be adopted if the experiment suggested were undertaken Prof. Tait, of McGill University, following the lead of Prof Dunn, replies without answering, which is perhaps just as well

Surely, when the editor of the *Countryman* uses the phrase "principles of breeding" he means the objectives in breeding, for the principles are the same whether one breeds for intelligence or for intestinal length; and what does he really mean by "the dog's point of view"? Would a bulldog prefer to be an Alsatian, or the Pekinese a whippet? Dr Darling's views concerning the extravagant and the fantastic make him remarkable amongst men It is solely because man has always been attracted by these that he has perpetuated them to produce such pleasing variety amongst domesticated birds and beasts He may not like the Pekinese, but many people do, and so does the Pekinese, and he is far from miserable so far as we can judge We have selected and fixed by breeding those characters of the dog that pleased or advantaged us, quaintnesses of all kinds, as well as special abilities Every kind of combination of form and behaviour exists By segregation and recombination new breeds could be manufactured, and by continued selection most of the qualities exhibited by the dog could be emphasised That such a great variety of types exists is merely a reflection of the fact that different people have different ideas as to what constitutes attraction in a dog. The world would be a much duller place if all the dogs in it were hill collies

There is, however, the germ of a really serious question in the musings of the editor of the *Countryman*, for show standards commonly do tend to demand a grade of physiological extravagance that is distinctly undesirable and, in certain instances, even definitely pathological Quite serious defects and derangements can easily be bred into a stock to its detriment deafness in the bull terrier, cleft palate in the bulldog, disharmony between the size of pelvis and the size of fœtus in the 'toys'. The exceedingly long ear-flaps of the spaniel lead to the development of hæmatomata and canker; the short bowed legs of the Scottie are associated with the development of interdigital cysts; the short-faced breeds suffer sadly from respiratory diseases, for the reason, it may be assumed, that they lack a proper air filtering and warming apparatus; and the fleece of the Old English sheep dog is the ideal home of external parasites No show standard should be allowed to continue which inevitably demands a high lethality in the breed or an obvious discomfort to the individual

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University and Educational Intelligence

ABERDEEN —Prof James R Matthews, professor of botany in the University of Reading, has been appointed regius professor of botany in succession to the late Prof. W. G Craib

LONDON —Mr David Brunt, since 1919 superintendent of the Army Services Division at the Meteorological Office, has been appointed University professor of meteorology (Imperial College—Royal College of Science) as from October 1, 1934. Dr. R. J. Lythgoe, since 1928 honorary lecturer at University College, has been appointed University reader in the physiology of the sense organs at the College as from October 1, 1933.

The title of 'Fellow of University College, London' has been conferred on the following, among others: Mr. C B Collott, chief mechanical engineer of the Great Western Railway; Dr E Mallett, principal of the Woolwich Polytechnic and head of the Electrical Engineering Department, formerly reader in electrical engineering, City and Guilds (Engineering) College, Mr H. J. Page, in charge of the Imperial Chemical Industries Experimental Station for Agricultural Research at Jealott's Hill, formerly head of the Chemical Department of the Rothamsted Experimental Station; and Dr A S Parkes, a member of the staff of the National Institute for Medical Research, Mount Vernon, Hampstead, formerly Sharpey scholar and honorary lecturer in physiology, University College, London

The title of 'Honorary Fellow of University College, London' has been conferred on the following Prof. Karl Pearson, professor of applied mathematics and mechanics at University College, London in 1884–1911, Galton professor of eugenics in the University of London in 1911–33, and Sir Flinders Petrie, Edwards professor of Egyptology at University College, London, in 1893–1933.

OXFORD —At the meeting of Congregation held on February 20, a decree moved by the Master of Balliol postponing the operation of certain portions of the Forestry Statute which was passed by Congregation on February 13 until August 1, gave occasion to a further discussion on the merits of the Statute Prof R V Southwell opposed the decree on the ground that the new Forestry Committee should have the opportunity of expressing its opinion on the question of the site He also pointed out that under the new Statute it was uncertain whether the professor of forestry would be able to exercise an effective control. Moreover, under the conditions of the Statute, the security of tenure of the staff of the Institute was incompletely provided for The honour of the University would not have been compromised by the rejection of the Statute, inasmuch as Congregation had a perfect right to a free vote on the matter

Dr H V Denham, director of the Institute of Agricultural Engineering, said that the experience of his department showed that the new forestry scheme might be expected to work successfully Prof F. A Lindemann complained that the Boards of Faculty concerned had not had the opportunity of seeing the Statute before it was proposed The Master of Balliol, replying on the whole debate, reminded the House that objections to the Statute should have been brought in the form of amendments, and not have been deferred until the Statute had passed.

The Vice-Chancellor having ruled that even if the decree were thrown out, the existing Board of Governors, and not the new Forestry Committee, would be concerned in the question of the site, the opposition was withdrawn, and the decree passed without a division

At the same meeting of Congregation, the gift by the Royal Society of £200 for astrographic work in the University Observatory was gratefully accepted.

In the *University Gazette* of February 21, the Hebdomadal Council gives notice that it has appointed a committee to collect evidence of the probable future building requirements of the University.

Science News a Century Ago

Polarisation of Light from the Sky

At a meeting of the Cambridge Philosophical Society on March 3, 1834, the Rev. Temple Chevalier described experiments which he had made on the polarisation of light from the sky. The general results were that light from the clear sky is polarised; that the effect begins to be sensible at points 30° distant from the sun, and that the maximum of polarised light proceeds from points at 90° distance from the sun; a fact which seems to indicate that the reflection which occasions the polarisation, takes place at the surface of two media as nearly as possible of the same density.

On March 10, Prof. Airy gave an account before the Society of experiments on the same subject. It appeared that the light is polarised in a plane passing through the sun, and that the plane of polarisation is not reversed in approaching the sun, as had been formerly suggested by M. Arago. Prof. Airy found that he could observe the polarisation within 9° of the sun, in a horizontal direction, but that above and below the sun the traces disappeared at a distance considerably greater. It was found in the course of these experiments that very rough surfaces, as a stone wall, a gravel walk, a carpet, produced some polarisation by reflection; and that the plane of polarisation in all cases passed through the point of reflection and the source from which the light came.

Forests of Holderness

On March 4, 1834, John Phillips, then keeper of the York Museum and professor of geology in King's College, London, read a paper to the Yorkshire Philosophical Society on the ancient and partly buried forests of Holderness. The country of Holderness, he said, was a large triangular district, bounded on one side by the "German" Ocean, on another by the estuary of the Humber, and on the third by the declining plane of the chalk. It was not properly a level but rather an undulating low district with isolated hills and devious ridges. The winding hollows which embrace the hills in the southern part of Holderness were generally filled with sediment from the tide which, if allowed free access, would cover them five, ten or more feet deep.

Phillips's paper had been written as a result of two visits to the district when a large drain nearly parallel to the River Hull had laid bare a considerable number of plant accumulations at a level greatly below that of the water of the Humber.

Hydro-Oxygen Microscopic Exhibition

On March 5, 1834, a hydro-oxygen microscopic exhibition was opened at Mr. Stanley's Rooms in Old Bond Street. Speaking of the exhibition, the *Times* declared it to be the most interesting the metropolis could boast, and one which to the man of science and the searcher after the mysteries of Nature was invaluable, by opening up sources of knowledge which, but for the powerful agency employed, must otherwise remain closed against all attempts at investigation. For those readers who had not seen the microscope, it was explained that it magnified the common flea to a size considerably greater than the largest elephant. The objects exhibited included the wings of insects and crystals of saline substances; special interest being displayed in some beautiful crystals of chromate of potash. "The ingenious gentlemen who superintend the exhibition likewise display some examples of the polarisation of light, which exhibit all the colours of Newton's scale of tints. These experiments attracted much attention from the scientific gentlemen who were present."

Royal Society, March 6, 1834

On this date the reading of a paper was commenced (Mr. Brunel in the chair), entitled "On the Structure and Functions of tubular and cellular Polypi, and of Ascidiæ" by Joseph Jackson Lister, F.R.S. The reading was resumed and concluded (Mr. J. W. Lubbock in the chair) on March 13, following. [Sir Joseph (afterwards Lord) Lister, who was one of the four sons of Joseph Jackson Lister, wrote the biography of his father in the "Dictionary of National Biography".] The paper was published in full, under a revised title, with four plates, in the *Philosophical Transactions* for 1834. Its modest opening sentences run thus:—"The more obscure functions of vitality are of such difficult investigation, and possess at the same time so high an interest, that anyone contributing, in however small a degree to increase our information regarding them, may hope to meet with indulgence. Having observed the existence of currents within the tubular stem of a species of *Sertularia*, their investigation led to additional particulars relating to that family of Zoophytes, and other compound animals more or less resembling them, some of which it is hoped may be new in physiology." The drawings in illustration were traced by a camera lucida slid over the eyepiece of the microscope; and the author recommended its use to other observers because of the facility with which correct graphic records and measurements might be obtained.

Sir Edward Parry in Australia

Admiral Sir Edward Parry, the distinguished arctic explorer, was as well known for his philanthropy as for his discoveries. The care of those under him was always a matter of great concern. After making three voyages in search of the North-West Passage, and holding for four years the office of hydrographer to the Navy, he was appointed Commissioner of the Australian Agricultural Company in New South Wales. This concern had been incorporated by Royal Charter and granted a million acres of land, for the purpose of promoting the production of fine merino wool and other agricultural produce. Its affairs, however, had been sadly mismanaged, and with the sanction of the Admiralty, Parry accepted the office of Commissioner. He left the Thames in July 1829, landed at Sydney in December, and shortly afterwards took up his residence at Carrington, on the harbour of Port Stephens, about ninety miles north of Sydney. Here he found full scope for his activities and it was afterwards said: "At Port Stephens he found a wilderness but left it a land of hope and promise." He laboured incessantly to improve the lot of the settlers, the convicts and the aborigines, opening schools, promoting games, and himself frequently conducting divine service. On March 9, 1834, he preached a farewell sermon which led his successor, Colonel Dumaresq, to remark to a friend: "I have travelled a great deal during my life, and mixed much with men, but," pointing to Sir Edward, "in all my travels I never met with his equal."

Societies and Academies

London

Royal Society, February 22 A S Parkes and M Hill Effect of absence of light on the breeding season of the ferret Bissonnette's discovery that additional illumination would induce œstrus in anœstrous ferrets has naturally led to speculation as to what controls the onset of the breeding season in the normal ferret An obvious interpretation of Bissonnette's results was that the beginning of the breeding season of the normal female ferret in April is due to the increasing duration of daylight This hypothesis was put to experimental test by keeping ferrets in darkness from the latter part of anœstrus onwards From the results it is concluded that while additional light will induce œstrus in anœstrous animals, the onset of the breeding season in the spring is not dependent on the increasing length of daylight L E. S Eastham Metachronial rhythms and gill movements in relation to water flow in the nymph of *Cœnis horaria* (Ephemeroptera) By means of the oscillatory movements of four pairs of gills, the nymph produces a flow of water across the body from one side to the other, the current being reversible The gills rise and fall in periodic motion, and in so doing they traverse an elliptical path and, by a pivoting movement, move at an angle with their own path of motion The metachronial rhythm in the movements of the gills along each side of the body is from before backwards, but the gills of one side in motion are always out of phase with those of the other A transverse rhythm therefore exists across each pair of gills, which rhythm is in the direction of the water flow across the body It is reversed when the direction of the water current is reversed Reversal of flow is associated with changes in the method of pivoting of the gills , their manner of overlapping as members of pairs , the direction of the transverse rhythm over the gills F J W Roughton The kinetics of hæmoglobin (4–7) The methods of Hartridge and Roughton for the study of the velocity of rapid reactions were first applied by them to the reaction between hæmoglobin and oxygen The present papers extend the work to the 'sister' reactions of hæmoglobin with carbon monoxide. Velocity equations have been arrived at for (i) the combination of carbon monoxide with reduced hæmoglobin, $CO + Hb \rightarrow COHb$, (ii) both phases of the reversible reaction, $CO + O_2Hb \rightleftharpoons O_2 + COHb$ The results do not accord theoretically with a chemical mechanism of the type $Hb_n + nCO \rightleftharpoons Hb_n (CO)_n$, but can in part be interpreted by Adair's intermediate compound hypothesis, according to which the reaction of oxygen or carbon monoxide with hæmoglobin takes place in successive stages New possibilities are, however, brought to light, notably when trying to explain the paradoxical observations that *p*H is almost without effect upon either phase of the reversible reaction $CO + O_2Hb \rightleftharpoons O_2 + COHb$

Paris

Academy of Sciences, January 8 (*C R* , 198, 129–212) J Costantin · The varieties of wheat resistant to rust After summarising the unsuccessful efforts to produce rust-resisting wheats by hybridisation, and recalling the favourable results in combating sugar cane disease by employing plants of mountain origin, the author directs attention to the important work of Burton in Kenya on the effects of high altitude on producing rust-resisting wheats d'Ocagne : The idea of the instantaneous circle in the theory of plane motion Louis de Broglie The nature of the photon. Jean Loiseau . Curves admitting one or several infinite families of circumscribed triangles equally between themselves. E. J. Gumbel · The moments of the final distributions of the first and last value. N Aronszajn . The invariants of transformations in the domain of *n* complex variables. Albert Portevin and Michel Cymboliste A method for the study of the elastic deformations in metallic pieces submitted to external stresses. J. Baubiac . The transitory regimes in the movement of liquids and the beginning of the turbulent regime. D Barbier The eccentricity of double stars of very long period. Mme. G Camille Flammarion and F Quénisset · Photographs of the variations in the brightness of the star RS Ophiuchi. Maurice Lambrey and S Krauthamer The working of the bigrid frequency changer Ilie C Purcaru · Contribution to the experimental study of the electric discharge Results obtained with a kinematograph with very rapid film. Mlle Thérèse Meyer : The electrical conductivity of insulating or feebly conducting liquids in thin layers The variations with temperature Mlle O Jasse Measurements of the refractive indices of water by an interference method The refractive index of water for four wavelengths is given for temperatures between 0° C and 93 5° C P. Rouard . The change of phase by normal reflection on very thin gold layers Charles Launeau . The acyclic terpene alcohols, $C_{10}H_{18}O$, in the essential oils of citronella, geranium and rose V Henri, Ch Weizmann and Y Hirshberg The action of the ultra-violet rays on glycocol The first stage of the reaction is the formation of ammonia and glycollic acid The gaseous products include a large proportion of carbon monoxide P Lebeau and P Corriez The electrical resistivity of the peranthracites The resistivities of peranthracites, always greater than graphite, are, however, much smaller than those of true anthracites and coals J. Perreu The equation of solubility of hydrated salts F Bourion and E Rouyer . The determination of the total hydration of the ions of calcium chloride Ch. Lapp and Mlle G Zalc The rotatory dispersion of sparteine in aqueous solution Mme M Demassieux and Edwin J. Grelis . Some complex halogen salts of lead. Study of the system lead bromide, ammonium bromide, water P Carré The mobilities of the organic radicals in their bromosulphites Robert Lespieau and Joseph Wiemann · Syntheses of dulcite and of allodulcite L. Royer . The foreign materials which, added to the mother liquor of a solution, are susceptible of modifying the facies of the crystals of the dissolved substance Léon Bertrand . The relations of the primary axial zone of the Pyrenees and that of the north Pyrenees zone M Blumenthal The existence of antibetic thrusts in Andalusia Robert Laffitte The presence of the Albian in Aurès (Algeria) René Vandendries The sexual barriers in *Lenzites betulina* Mme. Hurel-Py . Researches on the *p*H conditions necessary to obtain the germination of pollen grains, and the vital coloration of their vacuoles A and R. Sartory, J. Meyer and Ernst · The inhibiting influence of radium on the growth of the rootlets of *Lens esculenta* modification of the minimum hindering dose under the influence of antagonistic ions. L. Maume and J. Dulac : Differences due to variety in the absorption of water, phosphoric acid and potash by wheats which have reached the same physiological period in the same medium F Marceau and L. Acolat · A new very sensitive cardiomyograph, with elastic wire, with both mechanical and optical amplification. A Paillot. A new type of disease with an ultra-virus in insects E Brumpt. Seasonal frequency and larval diapause of the fly, *Lucilia bufonivora* G Mouriquand and A. Leulier The calcium-phosphorus ratio in the genesis of experimental rickets and human rickets The greater tendency to rickets shown by infants fed on cows' milk compared with those fed on human milk cannot be explained by the change in the calcium-phosphorus ratio, since this is nearly the same in both milks

Cape Town

Royal Society of South Africa, October 18 A Ogg and E N Grindley: Declination at the University of Cape Town Magnetic Observatory August 1932–August 1933 A full programme of photographic recording of the declination, the horizontal intensity and the vertical intensity by two sets of la Cour instruments has been maintained at the Observatory during the year The daily variation curves of declination for each month, which have been determined, show interesting changes from month to month The curve for August 1933 is exactly similar to the curve for August 1932, with a secular variation of 4 2 minutes B F J. Schonland and B Delatizky Continuous recording of cosmic ray intensities. Instruments for obtaining continuous hourly measurements of the intensity of the cosmic radiation have been installed at the University of Cape Town. The records are obtained automatically. The station forms part of the international scheme for the study of variations in intensity of the rays with time organised by a European committee, and is the only one in the southern hemisphere. The station has been in continuous operation since February 1933, and will be carried on for another year The accuracy of observation is 0 1 per cent D M Beach · Phonetics of the Hottentot language The paper is based on the analysis of the pronunciation of more than a hundred Hottentot speakers, representative of all the Nama tribes, as well as Bergdama, Korana and Griqua. The Nama dialect is taken as a standard and described in detail Hottentot is a tone-language of the Chinese type, and there are six inherent tonemes of roots H A. Shapiro and H Zwarenstein. A rapid test for pregnancy on *Xenopus Laevis* Early morning urine from women is precipitated with 96 per cent alcohol. The precipitate is extracted with ether to remove œstrin and toxic substances, and the residue is then dissolved in distilled water 2–3 c.c. of the aqueous extract is injected into each of four female South African clawed toads. 12–18 hours later a positive reaction is indicated by either (*a*) extrusion of macroscopic ova through the cloaca, or (*b*) post-mortem examination of the animal (in the absence of ovulation), when one ovum or more will be seen in either or both of the oviducts respectively. Correct positive tests have been obtained as early as 20 days after the first missed menstrual period.

Geneva

Society of Physics and Natural History, November 2. C. E. Guye: Molecular dissymmetry and micellar dissymmetry. The author refers to the works of Curie on this subject. The action of the isolated molecules or of the large directed molecules should be favourable to the production of dissymmetry in the medium which surrounds them, and hence the molecules have more numerous possibilities of action in this medium. In this connexion, the author considers the results of work carried out on colloids by Lumière, De Vaux and others, who have shown that the vital element of the cell or of the serum would not be the micelle element but rather the molecular element He quotes a certain number of facts in favour of the molecular theory of the vital element. A. Schidlof · The constitution of heavy nuclei J Weigle A precision method for measuring rhombohedral lattices. A method of extrapolation of the experimental results gives an average of the exact values of the X-rays for the constants characterising non-cubical lattices This method applied to sodium nitrate gives for the wave-lengths of the edges of the elementary rhombohedron 6 3108 × 10^{-8} cm and 47° 15′ 59″ for the angles which they form between them H Saini The thermal expansion of silver by X rays The author has determined the coefficient of expansion of silver by X-rays between 20° C and 300° C using a Seeman-Böhlin chamber specially constructed for the study of expansions Results. lattice constant of silver at 18° C, $a = 4\ 0772 \times 10^{-8}$, coefficient of expansion $(19\ 1 \pm 0\ 2)10^{-6}$ degrees^{-1} E Friedheim Two natural reversible oxido reduction systems Lawson and juglon. The pigment of the sarcocarp of nuts The Juglan walnut and the pigment of *Lawsonia Inermis*, Lawson, or henna, are systems of reversible oxido-reduction Their normal potential is for *p*H 7 0 at 20° C, $E = +0\ 033$ (Juglan), $E = -0\ 139$ (Lawson). Since the juglon in the living plant is found essentially in the reduced state and the Lawson in the oxidised state, the oxido reduction potential of the plant cells in question is determined by the two values indicated E. Friedheim. Concerning the mechanism of the respiratory catalysis by systems of reversible oxido-reduction. The two reversible natural pigments, Lawson and juglon, increase the respiration of the red corpuscles of the rabbit by about 600 per cent, juglon forms methæmoglobin but Lawson does not The respiratory catalysis of the red corpuscles by systems of reversible oxido-reduction is thus independent of the formation of methæmoglobin as would follow from the theory of Wendel and Warburg The formation of the methæmoglobin is in fact concomitant, depending on the oxido reduction potential level and in addition, on conditions of kinetic order J. J. Pittard: Observations concerning the proportion of gold in the water courses of the Canton of Geneva. The author has proved that the stream is richest in gold in the middle part of its course in Swiss soil.

December 7. R Wavre. Some remarks on the theory of harmonic functions The author presents three notes. a reciprocal of Green's theorem, the unity of a potential defined by its line of ramification and its period function, and the development of Poisson's integral in a series of powers of the distance from the centre, if the Fourier coefficients are taken only on an arc ψ_1 and ψ_2 from the circumference, the harmonic function given by the integral admits the two points ψ_1 and ψ_2 as points of ramification. G. Tiercy: The new 40-cm. reflector of the [Geneva] Observatory. F. Battelli, D. Zimmet and P. Gazel: The muscular contraction of the discharge after the passage of continuous current.

SYDNEY

Linnean Society of New South Wales, October 28 T. G SLOANE. Notes on the Australian species of the family Paussidæ This paper has been prepared by H J Carter from notebooks of the late T. G. Sloane which are now in the Linnean Society's possession Various groups of the genus *Arthropterus* are tabulated, and notes given on a number of species described in 1924 by H Kolbe. Five species are described as new H M R RUPP The genus *Pterostylis* (Orchidaceæ) A new scheme of classification, with notes on the distribution of the Australian species The primary sections are two in number, based upon the character of the labellum—laminate or filiform-terete The latter section contains two species only, strikingly distinct from all others in other features besides the labellum The much larger laminate section is divided first into subsections based upon the character of foliation T L BANCROFT Further observations on the rearing of *Ceratodus* Attention is directed to the variations in size found in young fish of the same age and to the errors that may consequently appear in embryological work when length is used as an indication of age LILIAN FRASER An investigation of the sooty moulds of New South Wales (1) Historical and introductory account There are two types (*a*) perennial moulds which develop on shrubs and trees, and (*b*) annual moulds which develop on annual herbs attacked by aphis and often precede the perennial moulds on trees and shrubs G H HARDY Miscellaneous notes on Australian Diptera (1) Thirteen species are described as new in various families of the Brachycera, generic keys are given to subfamilies Hermetinæ and Pachygasterinæ, and a key to the genus *Pelecorhynchus* Two species of Scenopinidæ are the first to be described from Australia

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Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Saturday, March 3

ROYAL INSTITUTION, at 3 –Lord Rutherford "The Transmutation of Matter" (succeeding lectures on March 10, 17 and 24)

Monday, March 5

ROYAL GEOGRAPHICAL SOCIETY, at 8 30—D Dilwyn John "The Second Antarctic Commission of R R S *Discovery*"

Tuesday, March 6

ROYAL SOCIETY OF ARTS, at 4.30 —Sir Wilfred Grenfell "Newfoundland and Labrador"

Wednesday, March 7

ROYAL SOCIETY OF ARTS, at 8 —J W Ryde "Electric Discharge Lamps"

ROYAL ENTOMOLOGICAL SOCIETY OF LONDON, at 8.—Prof P A Buxton '*Glossina* and Climate, Studies in the Laboratory"

Thursday, March 8

ROYAL SOCIETY, at 4 30 —Dr J. Chadwick, Prof P.M.S. Blackett and G. Occhialini "Some Experiments on the Production of Positive Electrons"

G Temple 'The Quantum Theory of the Neutron"

EAST LONDON COLLEGE, at 5 30 —Prof J Kendall. "Elements, Old and New" *

Friday, March 9

ROYAL SOCIETY OF ARTS —D G Harris "The Recent Progress of Irrigation in India"

ROYAL INSTITUTION, at 9 —Sir Claude Hill "Society and Caste in the India of To day"

INSTITUTE OF METALS, March 7-8 —Twenty sixth annual general meeting to be held at the Institution of Mechanical Engineers, Storey's Gate, London, S W 1.

March 7, at 10 –-Dr H Moore Presidential Address

Official Publications Received

GREAT BRITAIN AND IRELAND

Grading Rules and Standard Sizes for Empire Hardwoods intended for Shipment to the United Kingdom Prepared by the Advisory Committee on Timbers, Imperial Institute Pp 17 (London Imperial Institute) 1*s*

Lecture on "Electrometric Methods in Physical and Analytical Chemistry" By Dr Samuel Glasstone Pp 39 The Chemist as a Directing Force in Industry By Dr Herbert Levinstein (The Fifth S M Gluckstein Memorial Lecture 1933) Pp 22 (London Institute of Chemistry)

Department of Scientific and Industrial Research Report of the Water Pollution Research Board for the Year ended 30th June 1933 with Report of the Director of Water Pollution Research Pp iii+50 (London H M Stationery Office) 1*s* net

The Scientific Proceedings of the Royal Dublin Society Vol 21 (N S), No 3 Abnormal Cones of *Fitzroya* and their Bearing on the Nature of the Conifer Strobilus By Joseph Doyle and Mary O Leary Pp 23-35 + 1 plate (Dublin Hodges, Figgis and Co London Williams and Norgate, Ltd) 1*s* 6*d*

OTHER COUNTRIES

The Indian Forest Records Vol 18, Part 13 Entomological Investigations on the Spike Disease of Sandal (12) The Life-History and Morphology of *Eurybrachys tomentosa* Fabr Fulgoridæ (Homopt) By N C Chatterjee Pp iv+26+2 plates (Delhi Manager of Publications) 12 annas 1*s* 3*d*

Bibliography of Lac By A C Chatterjee Pp 129 2 8 rupees Bulletin No 16 *Aspidiotus* (*Furcaspis*) *orientalis* Newstead (Coccidæ), its Economic Importance in Lac Cultivation and its Control By P M Glover Pp 23+1 plate 1 4 rupees (Ranchi Indian Lac Research Institute)

Borough of Durban Durban Museum and Art Gallery Annual Report for Municipal Year, 1932-33 Pp 12+4 plates (Durban)

An Outline of the Physiography, Geology and Mineral Resources of Nyasaland, 1932 By Dr F Dixey Pp 34 (Zomba Geological Survey Department)

N Z Department of Scientific and Industrial Research Bulletin No 43 Report of the Hawke's Bay Earthquake (3rd February 1931) Pp 116 2*s* Seventh Annual Report for the Year 1932-33 Pp 82 2*s* 6*d* (Wellington Government Printer)

Obras completas y correspondencia científica de Florentino Ameghino Vol 11 Ungulados aves y desdentados Dirigida por Alfredo J Torcelli Pp 917 (Buenos Aires El Gobierno de la Provincia de Buenos Aires)

Report of the United States National Museum, 1933 (Part 2 of the Report of the Secretary of the Smithsonian Institution to the Board of Regents for the Fiscal Year ended June 30, 1933) Pp 69-194 (Washington, D C Smithsonian Institution)

The Nosu Tribes of West Szechwan Notes on the Country and its Peoples and on the Diseases of the Region By Dr H R Cunningham, Dr Leslie G Kilborn, Dr James L Maxwell, Dr W R Morse, Dr Harrison J Mullett and F Dickinson (Supplement to the *Chinese Medical Journal*) Pp iv+56+8 plates (Shanghai Henry Lester Institute)

U S Department of the Interior National Park Service Fauna of the National Parks of the United States a Preliminary Survey of Faunal Relations in National Parks By George M Wright, Joseph M Dixon and Ben H Thompson (Contribution of Wild Life Survey, Fauna Series No 1) Pp iv+157 20 cents History and Present Status of the Breeding Colonies of the White Pelican (*Pelecanus erythrorhynchos*) in the United States By Ben H Thompson (Contribution of Wild Life Division, Occasional Paper No 1) Pp vii+84 (Washington, D C Government Printing Office)

State of Connecticut State Geological and Natural History Survey. Bulletin No 52 Fifteenth Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1931-1932 (Public Document No 47) Pp 24 (Hartford, Conn.)

U S Department of the Interior Office of Education Bulletin, 1933, No 12 The Education of Native and Minority Groups, a Bibliography, 1923-1932 By Katherine M Cook and Florence E Reynolds Pp v+57 (Washington, D C Government Printing Office) 5 cents

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CATALOGUES

Anepidem for the Treatment of Influenza and the Common Cold Pp 2 Radio-Malt the Vitamin Malt Food containing Standardised Amounts of Vitamins A, B_1, B_2 and D Pp 10 Radiostoleum (Standardised Vitamins A and D) Pp 4 (London The British Drug Houses, Ltd)

Scientia Naturalis ante annum 1800 Pp 60 (Berlin W Junk)

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Science and Philosophy

THERE was a blissful time when human knowledge was not formally differentiated. Without going far back into history, we may recall the wise men of ancient Greece, who never thought of drawing a distinction between mathematics and natural science, psychology and moral science So Thales and Pythagoras are hailed as the true founders of practically every major branch of knowledge Indeed, the early Greek thinkers were at the same time not only philosophers and social reformers, mathematicians and physicists, but also politicians and soldiers, engineers and traders—a fact which suggests a special conception of the unity of knowledge, if not of knowledge and action as well Even the teaching of the Academy and the Lyceum, following the Pythagorean tradition, had a universal character, though some members of these schools specialised in particular branches of learning It was not until the Alexandrians that the various sciences were really differentiated and studied separately

This unitarian conception of knowledge was developed in a most remarkable and inspiring way To take but one example, the Pythagoreans considered number not only as the basis of abstract science but also of music, ethics and religion. Such doctrines as that of the harmony of the spheres, or of the correspondence between certain numbers and the moral virtues, may appear fantastic Yet, they have a profound meaning; and strange as it may seem to be, mathematics was one of the fundamental causes which influenced the social activities of the Pythagorean order. Indeed, the discovery of the irrational quantities was the spiritual cause of the breakdown of the Brotherhood But the spirit and the method remained · it was the necessity of 'explaining' the irrationals which led Plato to build up a philosophical system in which mathematical and scientific ideas were freely used, for the justification of both Nature and the world of ideas

It was only natural that all knowledge should be one when the particular sciences were in their infancy. There is, however, a deeper meaning in the unitarian attitude of the Greek mind . it illustrates the fact that the growth of mathematical and scientific ideas is intimately interwoven with the threads of philosophy proper This attitude can be traced all through the ages up to the cosmological disquisitions of Copernicus, of Kepler, of Newton himself. Again, we find the mathematical and physical discoveries of Descartes influencing his 'method', his philosophy, his cosmology and even his biology, and suggesting to Spinoza a geometrical proof of the dictates of conscience With Leibniz we can see how the idea of the 'infinitesimally small' is made the basis not only of the calculus, but also of his conception of substance, of monads and their pre-established harmony, of psychology, ethics and theology Further, though Kant's philosophy opens with this fundamental question 'How is pure mathematics possible ?', its collapse was largely due to the discovery of non-Euclidian geometry and to the invention of imaginary quantities which could not be easily explained with that system

Kantian philosophy was, however, responsible for the definite estrangement of science and philosophy in the nineteenth century Science was firmly attached to the realm of pure reason, while the major values of reality were left to the charitable conclusions of practical reason, the arbitrariness of which ultimately cast doubts on the relevance of philosophical issues to the claims of positive knowledge. The alliance of the sciences with reason and the remarkable scientific developments of the time, led the Positivist school to discard philosophy from the sphere of human concerns With philosophy at a discount, the way was clear for a mechanist and materialist interpretation of the universe and of life The notion that to be real a thing must be of the same nature as a piece of matter, became the predominant axiom upon which was based any explanation of scientific results , and as matter can be seen and touched, whatever was real ought to be seen and touched, at least theoretically The analysis and description of a thing in terms of molecules and atoms and their movements was the sole condition of dealing with reality , all else, such as metaphysical values and religious experience, was a pointless incursion into a world of shadows Yet, it is a curious fact that the further analysis of the objects perceived finally exploded the very 'reality' they represented

This is, however, the epic of the contemporary development of our knowledge With matter considered as a hump in space-time and gradually vanishing into nothingness, the obvious and solid foundation of nineteenth century science has disappeared The imaginative conception of reality no longer being restricted by its likeness to the objects of perception, there could be no reason why the promptings of moral, æsthetic and religious experience should be still considered as unreal, and the way was thus open for a reconsideration of the philosophical interpretation of the universe on its merits The immediate effect of this new situation was to narrow the gulf between science and philosophy Physicists began to look for a solution of their particular problems in the boundless extent they discovered beyond the traditional horizon of physics In reaching out to those inquiries, philosophers became more and more interested in the methods and results of the special sciences, and brought down metaphysics into the laboratory and the market place

What are the results of this welcome cooperation ? Eminent astronomers and physicists like Eddington, Jeans, Planck and Einstein, do not conceive the world of matter as something existing independently of the mind Not only does scientific thought affect the nature of the things it studies, but also matter itself becomes simply an appearance of the mental or spiritual unity which alone is real Compared with the dogmatic pronouncement of their predecessors fifty years ago that matter alone was real, the present attitude of these scientific thinkers is its extreme opposite This complete reversion is the more arresting when one considers that matter which, in the past, was subject to the blind laws of classical mechanics, is now endowed with something almost like free-will, thanks to the implications of Heisenberg's principle of indeterminacy With Whitehead, Russell, and the idealist philosophers, this peculiar character of matter is further emphasised

The important consequences of such views in the field of biology are that life is not a by-product of blind processes of dead matter, but something fundamental and creative, exhibiting its own purposes and ends Hence arise theories of creative evolution in which the processes of life continually bring to birth something new Even those who refuse to accept a fundamental distinction between matter and life have to talk of emergent evolution, of 'organism' and of 'holism'. Whitehead, for example, considers the universe as an organic whole of which the living organism is a pattern , while Smuts assimilates biological progress with the integration of more and more elements to form larger and larger organic wholes.

When we reach psychology, however, we find the position again reversed Two generations ago, psychology was not acknowledged to be a science, on the ground that it was mainly introspective, and therefore subjective, it gave too much importance to mind as against matter, which was, as we have seen, the ultimate basis of reality To-day, however, psychology is becoming more and more objective, and with the advent of behaviourism or the conditioned reflexes, it describes the processes of the living organism in terms appropriate to a highly complicated automatic machine We are thus faced with the conclusion that freedom, which physics allows to dead matter, is refused by psychology to thinking organisms Indeed, while the highest achievement of physics is to have become subjective, the last word in psychology is to give that science an objective character

Between such extreme views, of course, a number of intermediate theories have taken their place, and though the most prominent properties of physics and biology, in the minds of some of their brilliant exponents, are their subjectivism, there are a number of physicists, biologists and philosophers who still hold mechanistic or dualistic views on the interpretation of these sciences Again, behaviourism, the doctrine of conditioned reflexes, and psycho-analysis, are not the only representatives of psychological theories idealism and dualism have still a strong following in this field This chaos of values indicates clearly that science does not tell us the whole truth about things, but only partial truths about those aspects of things which can be subjected to its methods In other words, science is not the only guide which can help us in the exploration of the universe and in the interpretation of our findings On the other hand, without the theoretical and practical data of the sciences, philosophy alone could neither undertake its scrutiny of reality, nor carry our minds to the highest flights of purposive thinking.

This mutual dependence of science and philosophy is one of the major characteristics of the intellectual atmosphere of our time Neither of them is a detachable unit in an unorganised aggregate, or an independent agent which is not itself acted upon they are both living members in the organic whole of knowledge Science and philosophy have emerged from man's contact with Nature, and have become social habits, but they are customs so geared with the world about us that they must run smoothly, irrespective of climate, race or creed. As man is a social as well as a rational animal, the vast complex of social, emotional and intellectual behaviour he has inherited from society, cannot be simply dismissed in the name of science if it cannot be described in abstract formulæ On the other hand, as science is a social outgrowth serving social ends, all attempts to isolate any aspect of it from the intellectual and social movement, of which it is an integral part, can lead to nothing but false and dangerous conclusions It is true that the scientific analysis of the universe of experience requires its division into a series of differentiated compartments, and the isolation of subjects and objects from their original context, but it would be improper and misleading to build up elaborate structures on these isolated groups, as if there were originally water-tight compartments of knowledge, each having its own independent criteria of importance On the whole, our schools and our universities seem to be designed to accentuate the practice of isolation, though the pursuit of any one thing cannot be a complete end in itself.

The reconciliation of science and philosophy we witness to-day ought to change the practical conditions of such an outlook if we believe in the constant progress of civilisation and in the greatness of human destiny An important step in the right direction would be for the academic authorities to introduce the study of philosophy and scientific method as compulsory subsidiary subjects in the official curricula for a first degree But this brings us back to the attitude of the wise men of ancient Greece, who naturally thought of human knowledge as essentially one, as against the atomised outlook of most thinkers of to-day. Whatever be the specialised fields of scientific workers, they should know how to turn to philosophy for the connecting links between their diverse interests, so as to be able to discuss with competence the true significance and value of their results On the other hand, it should be the business of philosophers not only to inquire into the higher values of life, but also to subject to a critical analysis all the presuppositions and results of science, and to build up synthetic systems of the whole realm of knowledge and experience At every new step in human progress, we find men of genius able to make synthetic attempts of this kind But while to-day science may rightly claim to have performed its part, philosophy is still in the expectation of actual systems which will provide a comprehensive explanation of the results of science and an adequate justification of the periodical and progressive changes in the material conditions and mental outlook of the human race

The Eighteenth Century Scene*

By DR ALLAN FERGUSON

WHAT is the secret of the fascination which the character of Johnson has exerted on his friends, his contemporaries, and all lovers of England for nigh on two centuries? There are no half measures about it—if you know your Johnson, you like or dislike him heartily—and the great-hearted sturdy figure has to-day, even as in his lifetime, far more friends than enemies. It is curious, too, and a reflection in some measure of his powerful personality, that his is one of the few great names in our English life and literature of whom it can be said that their reputation never suffers from the swing of the pendulum We hear little of Carlyle and Ruskin to-day; Tennyson, after suffering a temporary eclipse, is coming into his own again; following a period of obscurity, the personality and achievements of Gladstone have provided material for half a dozen recent monographs But since the day of Johnson's death the stream of comment and of criticism has never run dry. Apart from the work of the compilers of *Ana*, successive editions of Boswell by Malone, Croker, Napier, Fitzgerald, Birrell, and greatest of all, Birkbeck Hill, not to mention the misguided efforts of one or two editors to present us with a 'bowdlerised' Boswell from which the 'longueurs' have disappeared, are milestones through the nineteenth century.

Year after year sees our knowledge of Johnson now growing, now darkened by the efforts of some thesis-mongering critic who attempts to sound the depths of his complex personality with a wholly inadequate plumb and line But whatever may be our estimate of the attempts, the volume of contemporary criticism shows, eloquently enough, the interest which he provokes in any age What is at the root of it all? Let us at once anticipate the drawing-room critic by admitting the worst which can be said of him. He could be, at times, violent and overbearing, he was occasionally uncouth and absent-minded, his literary fame and greatness of mind brought small consolation to the housewife who saw her best carpet disfigured by the moralist's habit of turning his candle upside-down to make it burn more brightly, he was indolent by nature, he would argue for victory, and his temperament had a hypochondriacal and melancholy side.

All this is true enough, but it must be remembered that our critical reading is not only coloured by what we term our judgment, and our friends our prejudices, but also that the very account which we read is as much a reflection of the mentality of the writer as it is an appreciation of the figure mainly concerned. Johnson has suffered somewhat at the hands of conventional commentators, more skilled to pick out faults than to see the nobility behind them, or to realise that Johnson without his scars ceases to be Johnson. He *was* indolent; and the mass of sound work behind his name should put to shame the most industrious of his critics; he *was* overbearing and inclined to use the butt-end of the pistol in argument—as when, finding himself worsted in a discussion on the virtues of medicated baths, he cried · "Well, sir, go to Dominicetti, and get thyself fumigated, but be sure that the steam be directed to thy head, for *that* is the peccant part"

Johnson was, however, so frank in apology, so ready to take the first opportunity of reconciliation, that incidents, which loom large in the minds of critics of the feebler sort, were seen in their correct perspective by those friends who knew him far better than we can hope to do, who were competent to assess at its true value the wisdom and goodness of him who, giving small weight to conventional expressions of sympathy ("Sir . . you will find these very feeling people are not very ready to do you good. They *pay* you by *feeling*"), took on his back a poor woman of the town whom he found lying ill in the street, carried her to his house and "had her taken care of . . . till she was restored to health and . put . . . into a virtuous way of living", who not merely passively endured, but cheerfully sustained for years a nondescript household of dependents with whose queerness and bickerings Shaftesbury himself would have had small patience. He would argue for victory, and would, in the mood, stubbornly maintain a completely wrong-headed attitude Yet few men have shown in discussion such cogency of argument, such genuine humour, such force and precision of language, such aptness of illustration Could the matter be more neatly put than in his comment on the assertion that a *congé d'élire* had only the force of a recommendation? "Sir, it is such a recommendation as if I should throw you out of a two-pair of stairs window, and recommend you to fall soft". To the vague and woolly phrase and mind he was an uncompromising enemy ("Poll is a stupid slut; she was wiggle-waggle, and I never could persuade her to be categorical"). He had his melancholy fits and feared to be left in solitude. Yet none could be a gayer companion, witty and charming, welcome and at his ease in any company.

More than anything, Johnson was an amateur of life in all its phases His nature could extract a high and candid philosophy of life from keen observation of men and books, and, with one exception, he was utterly fearless, physically and morally. When, an elderly man, he was bathing with Langton and was cautioned against a dangerous pool, he thereupon swam directly into it; and—a higher virtue—he was never afraid to recognise aspects of human nature which the demands of conventionality tend to ignore A remark made by Reynolds, in Johnson's hearing, to ladies lamenting the loss of a benefactor—"You have, however, the comfort of being relieved from a burden of gratitude"—first attracted him to Reynolds; and it is an odd commentary on changing social values that this remark, recognised by Johnson in the eighteenth century as exhibiting a fair view of human nature, drew from Morley the comment that "no moralist with a reputation to lose would like to back Reynolds's remark in the nineteenth century" and is quoted by a twentieth century critic of Johnson as "the sort of thing which everyone knows to be true, but which very few venture to say".

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* "Johnson's England an Account of the Life and Manners of his Age" Edited by Prof A S Turberville Vol. 1 Pp xxiii+405+72 plates. Vol. 2 Pp ix+404+60 plates. (Oxford Clarendon Press, London · Oxford University Press, 1933) 42s net.

No man saw more clearly the vast gulf which lies between life as it is, and life as we endeavour to cheat ourselves into believing it to be It is this clarity of vision, despite his prejudiced views on many questions of the day, which makes Johnson's writings so rich a storehouse of those compressions of thought and observation which we term aphorisms His advice to Boswell—advice applicable to weightier matters than are exhibited in the illustrations—sums up the matter: "My dear friend, clear your *mind* of cant You may *talk* as other people do You may say to a man, 'Sir, I am your most obedient-humble servant', you are *not* his most humble servant You may say, 'These are bad times; it is a melancholy thing to be reserved to such times'; you don't mind the times You tell a man, 'I am sorry you had such bad weather the last day of your journey, and were so much wet'; you don't care sixpence whether he is wet or dry You may *talk* in this manner, it is a mode of talking in Society; but don't *think* foolishly"

With this practical wisdom, goes a boyishness of spirit, and a very endearing capacity for exhibiting certain human weaknesses Witness Mrs Thrale when "I had teized him for many weeks to write a recommendatory letter of a little boy to his schoolmaster; and after he had faithfully promised to do this prodigious feat before we met again—'Do not forget dear Dick, Sir,' said I, as he went out of the coach; he turned back, stood still two minutes on the carriage step—'When I have written my letter to Dick, I may hang myself, mayn't I?'—and turned away in a very ill-humour indeed" Most reluctant performers of allotted tasks will recognise a kindred spirit here, and in that illuminating entry in the diary of his Welsh tour which records that "We then went to see a Cascade. I trudged unwillingly *and was not sorry to find it dry*".

What were the characteristics of the scene in which Johnson played so dominating a part? To obtain a faithful picture of his personality we have to realise, not only the broad outlines of the events of his times, but something of that detail—*ce superflu, si nécessaire*—so dearly loved by Austin Dobson. We know that the stage played a large part in the life of the town—we may even know something of the line of development of the eighteenth century drama; but it adds much to the vividness of the portrait if we know that the audience were seated on backless benches, which could not be booked in advance, that the system of dropping the curtain between the acts was not introduced until the mid-century; and that Garrick revolutionised the whole system of stage-lighting by substituting unobtrusive wing-lights for the chandeliers which heretofore had hung *in front* of the stage, obscuring the view, and only half-illuminating the scenery.

In the long tale of man's conquest of Nature there is no more fascinating story than that of the slow degrees by which he improved his means of communication with his fellows We know that roads were vile at the beginning of the century, and tolerable at its close—so much improved indeed that the railway at its inception had only small advantages to offer But such knowledge has little value, we need to be able to visualise the coaches, waggons and post-chaises by which our ancestors travelled and, in the spirit of Lord Kelvin's dictum that we begin to know something of a quantity when we can say how much of it there is, we find our notions of the roads of the period clarified when we realise that about the mid-century a journey of fifty miles was a good day's work, and that towards the end of the century about a hundred miles could be covered in a day. Indeed, Arthur Young remarks about 1770, "The power of expeditious travelling depopulates the kingdom Young men and women in the country villages . . . enter into service . . . to raise money enough to go into London . . . no easy matter when a stage coach was four or five days creeping a hundred miles *But now!* A country fellow, a hundred miles from London, jumps on to a coach box in the morning, and for eight or ten shillings gets to London by night; which makes a material difference" *Plus ça change*—we seem to remember similar remarks made but recently concerning the effect of the motor bus on village life.

The study of the daily habits of our ancestors provides material of never failing interest What and when they ate and drank, the type of house in which they lived, the clothes they wore, the books they read, the manner in which they farmed their land. It is so very easy to visualise the century as one of a highly artificial civilisation, an age of panniers and hoops, of affected compliments and heroic couplets, of grand tours and olympic statesmen; or, at the other extreme, as one of gaol fever, of stinking streets and ditches, of Hogarth's Gin Lane, of highwaymen, street thieves and melancholy processions to Tyburn It is perfectly true that these extreme elements form part of the picture. But a part only; and it is the province of the volumes under discussion to correct such facile and distorted views. Nowhere is this correction more effectively made than in the section which deals with town life in the provinces Many readers of to-day are apt to project their present knowledge of, say, Leeds or Birmingham, back into eighteenth century conditions, and it is with something of surprise that we learn that, outside London, the only considerable English city at the middle period of the century was Bristol with a population of a hundred thousand Norwich came next, with a population of about fifty thousand , then Manchester and Liverpool in the region of thirty thousand The populations of Hull and Sheffield were between twenty and thirty thousand, those of Nottingham, Leeds, Shrewsbury, Chester and Worcester between ten and seventeen thousand Such towns as Bolton, Bradford and Newbury were not greater in population than five thousand souls, and most of the flourishing market towns of the period were no more than large villages of two to four thousand inhabitants Their problems of lighting, paving and sanitation were not markedly different from those which face corresponding English villages to-day Perhaps their solution was not so very much lower in point of efficiency , at the moment of writing, we hear news of deaths caused by the failure of water supply in villages under the stress of the drought of 1933.

The furniture of the houses of the period is known in minute detail The topographers of the age catalogued the more striking of the contents of the mansions of the nobility and gentry, and legal inventories and auctioneers' catalogues are not unknown One striking feature of the interior furnishings of the period is the small part which the bath and the bathroom play therein Johnson himself remarked to the Lichfield draper showing him his cold bath, "I hate immersion", admonishing him to "let well alone, and be content" , and we are told of the eleventh Duke of Norfolk that he was "never thoroughly washed except when he was so drunk that his servants were able to place him in his bath without his being sensible of it".

The section which deals with the house interior is remarkably full in its account of the furniture of upper class houses. Beautiful examples of period furniture are described and illustrated, but we would willingly have sacrificed some of this in order to obtain more knowledge of farms, cottages, alehouses and the village inn with

"The whitewashed wall, the nicely sanded floor,
The varnished clock that clicked behind the door,
The chest contrived a double debt to pay,
A bed by night, a chest of drawers by day ,
The pictures placed for ornament and use,
The twelve good rules, the royal game of goose,
The hearth, except when winter chilled the day,
With aspen boughs, and flowers and fennel gay ,
While broken teacups, wisely kept for show,
Ranged o'er the chimney, glistened in a row"

The paucity of this information is not fully compensated by an extract from Southey descriptive of an early nineteenth century farmhouse, or a brief description of the plates of "*Marriage à la mode*" One inventory which has escaped the author's notice—a catalogue of very deep interest to the readers of NATURE—is that which describes the contents of the house in the parish of St. Martin's-in-the-Fields, in which Sir Isaac Newton died Newton died intestate and, as was discovered by Lieut -Col. de Villamil, a very detailed inventory of the contents of his house was taken at the instance of the Prerogative Court of Canterbury. The records of this court are preserved at Somerset House, and a close search revealed the inventory in the form of a vellum roll some five inches broad and seventeen feet long The detail is remarkable, so much so that it would not be a difficult matter to refurnish every room in a reproduction of Newton's house in the exact style in which he lived The inventory would seem to fill a gap in the literature , it gives a very complete picture of a middle class house in the year 1727. Here again, despite an astonishing particularity of description which includes certain articles of bedroom furniture in silver, and descends to a tabulation of "a leaf of a table two old coats two old hatts a pair of tongs a perriwig block two leaden flower pots" in the stable, the only mention of a bath is found in the inventory of the "fore room two pair of stairs", where we read of "three globes a copper plate a silver watch a Bath mettle case of instruments a shagreen case Do a small penknife an embroidered purse two plaistered heads and two small pictures". We fear that the word *Bath* here refers to the alloy (three or four ounces of zinc to a pound of copper) of which the case is composed

It would be an impossible task to summarise adequately the contents of the twenty-seven sections of these volumes—sections which cover almost all of the activities of the age, and furnish us with a picture, most skilfully conceived and carried out, in which the immense detail necessary for any accurate scholarship is introduced into the main structure in so thoroughly interesting a fashion that its presence is never felt to be overwhelming, nor permitted to obscure the main outlines. We have seen that daily life and habits in the metropolis and in the provinces are adequately treated. The Church, the Army, the Navy, trade and rural life, travel and discovery, sports and costume, all find representation We are introduced to a study of the law of the period, a mass of queer, interesting and archaic technicalities wherein, for example, under a writ of debt, a defendant could wage his law, that is, could "swear that he did not owe the money . . and produce eleven compurgators to swear that they believed him" , and the defendant could escape scot free if he managed to find eleven such hard swearers ! True, the lawyers had discovered subtle ways to make the process difficult, but so late as 1824 such a case occurred, and the possibility was not finally disposed of until the Act of 1833.

The arts of painting, engraving, sculpture, architecture, the drama and music have each a section devoted to them, and three very important divisions deal respectively with medicine, education and science. The last-named section gives, as is natural, much of its space to the story of phlogiston and to the discovery and manipulation of gases Sections on authors and booksellers and on the newspaper close a study which provides material of most absorbing interest, and which may fairly be called indispensable to a student of the period. It will none the less prove attractive to the general reader and will receive an unstinted welcome from all sound Johnsonians We hope that Prof Turberville will continue the good work —a study of Tennyson's England covers almost the same period in the nineteenth century that is covered in the eighteenth by the present study, and it has its possibilities

Manufacture of Sheet and Plate Glass

IN a Friday evening discourse delivered at the Royal Institution on December 8, Major R M Weeks, of Messrs. Pilkington Brothers, Ltd, described, and illustrated by lantern slides and films, the methods in use for the manufacture of sheet and plate glass

The principal raw materials used in the manufacture of sheet and plate glass are sand, soda ash and limestone These materials, perhaps with the addition of arsenic, anthracite, alumina or magnesium carbonate, all in a finely divided condition, are intimately mixed prior to melting. There are two well-known processes for melting this mixture (1) The older method, in which the materials are melted in clay pots, and a definite time-temperature schedule is allotted to melting, founding, refining and cooling off to the working temperature As many as twenty melting pots are sometimes accommodated in one furnace (2) The more modern method, in which the mixed raw materials are fed on at one end of a tank furnace where they are melted The molten glass then flows through controlled temperature zones which ensure the founding and refining, and finally arrive at the working end at the required temperature Such tanks contain anything up to 900 tons, and the temperatures may vary from 1450° to 1200° C in different zones

Sheet glass was first made by a blowing and spinning process Such glass, known as 'crown glass', was characterised by the 'bull's eye' in the middle of each disc This method was followed in 1832 by the 'blown' process, in which the gathering of glass was blown into the form of an elongated cylinder After separating the cylinder from the blowing iron, the ends were cut off, and the cylinder split down its length and flattened into a sheet. In 1909, a mechanical method of drawing cylinders of a larger size was introduced from the United States By this method, cylinders 40 ft. long and about 3 ft. in diameter are drawn (Fig. 1) Such cylinders are cut up into sections before flattening and annealing

Since 1900, three processes for the drawing of flat sheet glass have been developed commercially: (a) Fourcault process, (b) Colburn or Libbey-Owens, and (c) Pittsburg process. In the Fourcault process, glass is drawn as a sheet vertically from a slot in a depressed fireclay float. In its early days, devitrification was a source of trouble. In the Libbey-Owens process the sheet is drawn from an open bath of molten glass, and thus excessive devitrification troubles are avoided, but the sheet when formed is reheated and bent to the horizontal by being passed over a bending roller The Pittsburg process is a modification of the Fourcault process, the chief difference lying in the use of a bar of fireclay submerged beneath the surface of the glass to define the position of generation of the sheet

FIG 1 Drawing sheet glass cylinders mechanically

The making of plate glass involves two distinct processes · (1) manufacture of rough glass blanks; and (2) grinding and polishing of these blanks. Since 1774, plate glass blanks have been cast from glass melted in pots Typical melting pots contain about a ton of glass and yield plates of about 300 square feet, at a thickness of 7/16 of an inch. The casting consists in taking the pot from the furnace and pouring the molten glass on to a smooth iron table in front of a roller. The rolled blank is then annealed, a process which in earlier times occupied three days, but now, for a blank ½ in. thick, occupies 2¼ hours

A modern modification of this process, due to Bicheroux, consists in pouring the molten glass between two rollers on to a moving table (Fig 2) The irregular beginning and end of the sheet are cut off while still hot by a guillotine and the trimmed sheet is then passed into an annealing lehr, from which it later emerges ready for cutting and polishing This process gives a smoother and flatter sheet than the older single roller process consequently, there is less loss of material and reduced time required for the grinding process.

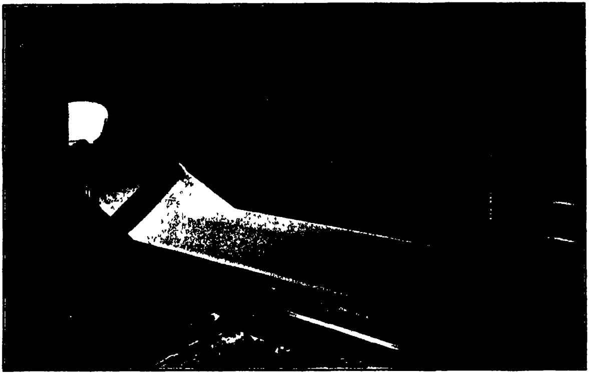

FIG 2 Casting plate glass blanks by the Bicheroux process

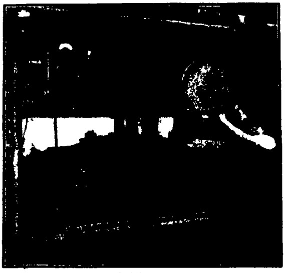

FIG 3. Polishing plate glass

The most modern process of all is a modification of the Bicheroux process, and consists in the continuous discharge of a stream of glass from a tank furnace between a pair of forming rolls, from which it issues in the form of a continuous ribbon or sheet, which passes over a roller bed and through an annealing lehr

In the second stage of the process of preparing plate glass, namely, grinding and polishing, the grinding is accomplished by using progressively finer grades of sand fed with water, under cast iron runners This is continued until a frosted surface of the finest possible texture is obtained The polishing process is then begun and consists in rubbing the glass with felt discs fed with carefully prepared rouge (Fig 3) All plate glass used to be, and much still is, ground and polished on rotating tables on which the glass is embedded, but this method has been superseded by a continuous process.

Machines used in this continuous grinding and polishing process are very large and expensive units; some are so much as 800 ft long by 15 ft. wide.

Two recent developments of note in flat glass manufacture are (1) coloured opaque glass known as "Vitrolite" and (2) toughened plate glass known as "Armourplate". The latter is made by the suitable heat treatment of ordinary plate glass

S. E.

Obituary

PROF FRITZ HABER

BY Fritz Haber's death, chemistry loses one of its outstanding personalities He was one of the greatest of academic chemists, of industrial chemists, and of leaders of research, while in his combination of these three rôles he was unique , at the same time he remained the most unaffected and kindest of men

Haber was born in Breslau on December 9, 1868 His early education as a chemist was unusual, and indeed, as he would often say, he was as nearly as possible a self-made man of science He attended courses in Berlin, Heidelberg, Charlottenburg, Zurich and Jena , he worked under Hofmann, Helmholtz, Liebermann (with whom he published his first paper on some derivatives of piperonal), Lunge and Ludwig Knorr, yet he never obtained from their courses the satisfaction which he desired As a young man he spent some months in various industrial works , he was even for a time in his father's office before he returned finally to science When he was twenty-six years old, he obtained a post as assistant to Bunte in the Institute of Chemical Technology at Karlsruhe, where his real work began, and where he remained for seventeen years

At Karlsruhe, Carl Engler and Bunte encouraged him to develop his own school of research Though Haber had received no formal instruction in physical chemistry, it was in this field that his main interests lay, and in a few years papers were appearing under his name on the combustion of hydrocarbons, the water-gas equilibrium in the Bunsen flame, and aspects of textile chemistry , but above all his main interests lay in the field of electro-chemistry His classical studies on electrolytic oxidation and reduction belong to this period , these began with his demonstration of the stages of the reduction of nitrobenzene (1898) This was followed by work on the electrolysis of solid salts (1904), on the glass electrode, on the velocities of electrode processes (1902–8) and on gas and carbon cells, all work showing him at the height of his powers Throughout the same time he was also engaged on his classical work "Thermodynamics of Technical Gas Reactions" (1905) His laboratory was filled with students from all parts of the world , unhampered by administrative cares, it was the most productive phase of his career

To this period also belongs the beginning of Haber's work on the synthesis of ammonia from its elements, work which led to the discovery of one of the most important of all industrial processes. His first paper on the equilibrium constants of this reaction appeared with Van Ordt in 1904, and in 1906, with Le Rossignol, he undertook a repetition of the measurements, over a much wider range of temperature and pressure It was then apparent that a catalyst which would operate satisfactorily at 600° C would make this process possible industrially, and to a man of Haber's breadth of vision the significance of the fact must have been immediately obvious An unremitting search was made for such a catalyst, and uranium and osmium were found to be effective A small technical high-pressure apparatus was constructed, and in June of 1908 two directors of the Badische Anilin- und Soda-Fabrik were invited to Karlsruhe to witness the first demonstration of the model at work After an initial failure, liquid ammonia was produced, and a process of enormous importance to Germany and to the world was launched Bosch and Mittasch undertook the task of converting the model into a full-scale plant, and with the constant shrewd co-operation of Haber the process was ultimately brought to the highest pitch of efficiency Haber received the 1918 Nobel prize for chemistry for this work

In 1906, at the age of thirty-eight years, Haber succeeded to Engler's chair, but left five years later to undertake the direction of the newly founded Kaiser Wilhelm Institut fur physikalische Chemie und Elektrochemie at Berlin-Dahlem Under his guidance this became the greatest research institution of its kind in the world , groups of research workers were left with the fullest freedom to develop their own ideas, while Haber gathered around him a devoted and talented staff whom he provided with every material and moral facility for the unhindered progress of their work No man ever had a more devoted band of colleagues, and no man ever spoke of them more appreciatively than he did

Haber's interest in the applications of the newer physics to chemistry was reflected in many papers at this time His work with Just, on the emission of electrons during chemical reaction, had been published from Karlsruhe , and after the War he continued in the same vein with his pioneer work on the physical meaning of chemi-luminescence, and on the applications of the methods of spectroscopy to the analysis of the processes of combustion

At the outbreak of the War, Haber was impressed by Germany's need for expert organisation of all her industrial resources He offered his services to the Prussian War Ministry, where he was soon installed as head of the Chemical Warfare Department There he worked unremittingly throughout the War. His advice and personal service were constantly in demand from all quarters, and such were his unrivalled knowledge and sanity of judgment that his name at this period became almost legendary throughout the country. He never sought to disclaim the responsibility for the use of poison gas, which was indeed the direct concern of his Department, but it should be remembered that latterly he gave up much of his time to serving on the League of Nations Committee on Chemical Warfare

The War years left him with shattered health, faced with the difficulties of reorganising an institution the funds of which were already dwindling owing to the monetary inflation, but with the secure conviction that only by the encouragement of research could German industry hope to regain its former position in the world. He played a leading part in the foundation of the Notgemeinschaft der deutschen Wissenschaft, and though some of his plans for the expansion of the Kaiser Wilhelm Institut had to be abandoned, it was not long before it was again in the forefront of research organisations. Meanwhile he himself was organising an attempt to pay the German War debt in gold won from sea-water, an attempt which failed yet yielded scientific results of importance.

The last years at Dahlem brought cares in plenty, but Haber's many industrial and administrative troubles were never allowed to interfere with the output of research from his private laboratory. The greater part of his work now was concerned with chain reactions and the mechanism of oxidation; perhaps his early association with Engler was responsible for this, and on this subject he worked with his assistants until the time of his death. He remained what he had always been, the ideal director of research, approachable, interested in everything, but above all the leader of the work of his Institute. His health was bad, but his industry enormous. Two honours he much appreciated were his election as an honorary fellow of the Chemical Society in 1931, and the award of the Rumford medal of the Royal Society in 1932.

The political situation in the spring of 1933 led to Haber's resignation. Almost all his staff and pupils were forced to look elsewhere for opportunities to continue their work, and he gave up his post rather than remain at Dahlem without them, in a country the political temper of which was so foreign to his own liberality of outlook. He spent himself unsparingly in helping his assistants and colleagues to find opportunities for continuing their work, and ultimately himself accepted an invitation of laboratory hospitality at Cambridge. He went to Cambridge in October and remained there to within a few days of his death. He had left for a short holiday on account of his health, intending to return to reside permanently at that University; but he died during the journey, at Basle, on January 29, 1934.

Haber was equally outstanding as a man and as a chemist. His amazing knowledge of politics, history and economics, as well as of science and industry, and his superb gift of expression made him a fascinating conversationalist. It was always a joy to hear him tell a story, whether it was an anecdote of the War or one of his famous medieval romances. After a paper or a colloquium he showed his powers at their fullest. Never at a loss, whatever the subject, he would always open the discussion with some characteristic contribution of his own, in a way which showed his complete grasp of the subject. One of his outstanding characteristics was his pride in his work; the final preparation of a paper was a work of infinite labour, but once it was completed he found it hard to accept any alteration in its conclusions; and though he was quick to acknowledge any mistake it was a source to him of acute mental discomfort. To his pupils he remained always courteous and affectionate, and to them his death is a great personal loss; but the world also is the poorer by the loss of one of its great benefactors and one of its great men.

O. H. W.-J.

DR. F. L. KITCHIN, F.R.S.

DR. FINLAY LORIMER KITCHIN was appointed palæontologist to the Geological Survey of Great Britain in 1905. He was attacked by sudden illness on January 17, 1934, and died in St. Thomas's Hospital on January 20. The post which he held for nearly thirty years was one which required an accurate and wide knowledge of the whole field of palæontological science, and he filled it with distinction and marked success. As a successor to such eminent men of science as Huxley, Salter, Etheridge, Shannon and Newton, he recognised the necessity of maintaining a high standard of performance and in no respect did his endeavours sink below the level of his predecessors.

Devoted to his subject, Kitchin was meticulously accurate, and at the same time he was able to co-operate freely not only with his official assistants but also with academic and other palæontologists who sought his advice. Being in charge of one of the largest collections of British fossils, on the curation and growth of which he had spent a large part of his working life, he acquired an experience of British stratigraphical palæontology which was probably unique. But he spared no efforts to secure the most accurate determinations, and he grudged neither time nor trouble, though often working on material which had less morphological value than stratigraphical interest. In this respect the value of his services to British geologists working in the field was unprecedented.

Kitchin's special sphere of work was in the province of Mesozoic palæontology. His earliest thesis, for the degree of Ph.D. at the University of Munich, where he studied under Zittel, was on Indian Jurassic Brachiopoda, and among his most important contributions to British palæontological stratigraphy were the two memoirs which he wrote with Dr. John Pringle on the Mesozoic rocks penetrated by borings in the coalfield of Kent. He also investigated the stratigraphy of the British Gault and contiguous formations, on which he wrote a number of useful papers. But he was very largely occupied by the preparation and editing of the palæontological chapters of memoirs on British geology, and the value of his services in this direction cannot be measured in terms of the amount of output which can now be attributed to his name.

For thirty years Kitchin held a leading place in the esteem of all his fellow workers, and his thoroughness and critical ability gained the confidence not only of his colleagues but also of all stratigraphical palæontologists both in Britain and abroad

Dr Kitchin was born in Whitehaven in 1870 and educated at St Bees School and at St John's College, Cambridge. After graduating at Cambridge he studied at Munich for several years For a short period he worked unofficially at the British Museum, and in 1898 he joined the Geological Survey as an assistant to E. T Newton He became palæontologist in 1905 He was a vice-president of the Palæontographical Society and a fellow of the Royal Society He took the degree of Sc D at Cambridge in 1923 For many years he had served on the council of the Geological Society, which in 1934 awarded to him the Lyell Medal, an honour which he did not live to receive

Dr. Kitchin had a very wide circle of friends who were attracted to him by his obvious sincerity and great willingness to help all earnest scientific workers. Of a retiring disposition, he was passionately fond of music and was himself no mean executant He was twice married and leaves a widow, two sons and one daughter On January 23, at Golder's Green, a large assembly of colleagues and scientific friends paid their last respects to a man of science, who was not only personally beloved, but had also taken an important part in the scientific activities of British palæontologists for nearly forty years J S F.

MR DOUGLAS W FRESHFIELD, D C L

MR DOUGLAS FRESHFIELD, who died in his eighty-ninth year on February 9, was prominent as a promoter of the serious study of geography for more than fifty years As an Eton boy he made several ascents in the Alps and his love of mountains grew with his growth He was recognised as one of the greatest mountaineers of the Alpine Club, but his attitude was that of an explorer and student of mountains rather than that of a sportsman, keen on records of first ascents He broke new ground in the Alps, the Caucasus and the Himalayas, and in his sixtieth year he started from Mombasa with the intention of making an ascent of Mt Ruwenzori, and he reached 12,000 ft before turning He wrote many books of much charm, the two largest, "The Exploration of the Central Caucasus" (1896) and "Round Kangchenjunga" (1903), are permanent works of great value, masterpieces of the literature of travel and illustrated with superb photographs His biography of the great Swiss mountaineer and man of science, H. B de Saussure (1920), was recognised as a classic

Mr Freshfield was admitted a fellow of the Royal Geographical Society in 1869 by Sir Roderick Murchison, and became a member of the council in 1878. Except for the ten years following 1894, when he withdrew from the affairs of the Society as a protest against certain retrograde tendencies, he served throughout his life as honorary secretary, vice-president, president (during the difficult War years 1914–17) and finally in the high office of trustee He was always a force for progress and in continuous opposition to the tyranny of old tradition His reserved nature and fine taste led him to shun publicity, but when the occasion demanded it, as in the fight for the admission of ladies as fellows in 1893, he took a prominent part and conducted controversy with cogent argument and caustic wit

Freshfield made no pretence of being a scientific man, but he preached and practised the doctrine of acute observation and accurate description. He rendered noble service to the science of geography by his encouragement of research and of higher education In 1884, recognising the futility of the Society's scheme of encouraging geographical education by offering prizes to the public schools, he initiated an inquiry into the state of geographical teaching on the Continent and secured the appointment of the late Sir John Keltie for that purpose The resulting report started the modern revival in British geography Mr Freshfield continued to urge that the best way to improve school teaching of the subject was to secure the recognition of the high cultural value of geography by the universities Starting with his own University of Oxford, he secured the appointment of Sir Halford Mackinder as reader in geography in 1887 when there was no chair of geography in any British university, and he lived to see professors and honours schools of geography in practically every one as the direct result of his initiative

For thirteen years Mr. Freshfield acted as president of the Geographical Association, the activity of which in its special province of education he watched over with an interest only exceeded by his devotion to the work of the Royal Geographical Society and of the Alpine Club

Freshfield's life was a fine illustration of the tradition of service which has led so many men of wealth and culture in England to toil for great ideals as strenuously as most men have to work for their living HUGH ROBERT MILL

WE regret to announce the following deaths

Mr E G B Meade-Waldo, an original member of the Society for the Protection of the Fauna of the Empire, on February 24, aged seventy-nine years.

Dr F C Purser, president of the Royal College of Physicians of Ireland and professor of medicine in the University of Dublin, on February 28

Mr William Barlow, F R S, known for his early work on the relation of crystal structure to chemical composition, on February 28, aged eighty-eight years.

Prof. S. F. Oldenburg, for twenty-five years permanent secretary of the Russian Academy of Sciences, on February 28, aged seventy years

News and Views

New Fellows of the Royal Society

THE following have been selected by the Council for election to the fellowship of the Royal Society :— Mr A S Besicovitch, Cayley lecturer in mathematics, University of Cambridge, Prof W E Curtis, professor of physics, Armstrong College, Newcastle-on-Tyne, Dr L L Fermor, director of the Geological Survey of India, Dr Paul Fildes, research bacteriologist, London Hospital; Dr R T Grant, lecturer in cardiac pathology, University College Hospital Medical School, London, Mr M A. C Hinton, deputy keeper of zoology, British Museum (Natural History), Dr. E L. Hirst, senior lecturer in organic chemistry, University of Birmingham, Dr E L Kennaway, director of the research laboratory, Cancer Hospital, London, Mr A G M Mitchell, consulting engineer, Melbourne, Prof W A Parks, professor of geology and head of Geology Department, University of Toronto, Prof H Raistrick, professor of biochemistry, University of London, Prof A O Rankine, professor of physics, Imperial College of Science, London, Lieut -Col R B Seymour Sewell, leader of the John Murray Expedition to the Arabian Sea, and director in 1925-33 of the Zoological Survey of India, Calcutta, Prof S. Sugden, professor of physical chemistry, Birkbeck College, London, Mr William Taylor, mechanical engineer, managing director of Messrs Taylor, Taylor and Hobson Ltd, Leicester, Dr H Hamshaw Thomas, University lecturer in botany, University of Cambridge, Rev Alfred Young, mathematician, rector of Birdbrook, Essex

New Fellows of the Royal Society of Edinburgh

AT the ordinary meeting of the Royal Society of Edinburgh, held on March 5, H R H the Duke of York was elected an honorary fellow The following ordinary fellows were also elected Dr D Bain, lecturer in technical chemistry, University of Edinburgh, Dr P Brough, lecturer in botany, University of Sydney, Prof I de Burgh Daly, department of physiology, University of Edinburgh, Dr F F Darling, chief officer of the Imperial Bureau of Animal Genetics, University of Edinburgh; Prof D R Dow, Department of Anatomy, University of St Andrews (University College, Dundee), Mr W L Edge, lecturer in mathematics, University of Edinburgh, Dr I M. H Etherington, lecturer in mathematics, University of Edinburgh, Mr G Fraser, chartered civil engineer, Prof J Glaister, Department of Forensic Medicine, University of Glasgow, Dr. R. M. Gorrie, Forest Research Institute, Dehra Dun, U.P, India, Mr D Haldane, senior geologist, H M. Geological Survey (Scotland), Edinburgh, Dr J V Harrison, geologist, Glasgow; Mr J Jeffrey, Under-Secretary of State for Scotland, Edinburgh, Sir William Johnston, Deputy Keeper of the Signet, Dr R. Cranston Low, formerly lecturer in dermatology, University of Edinburgh, Brigadier General Magnus Mowat, secretary of the Institution of Mechanical Engineers, London, Mr. W G R Murray, technical assistant, Department of Chemistry, University of Edinburgh, Prof A R Normand, Department of Chemistry, Wilson College, Bombay; Prof R K Pal, Department of Physiology, Prince of Wales Medical College, Patna, India, Dr H J Plenderleith, Research Laboratory, British Museum, London, Dr D E Rutherford, Carnegie Teaching Fellow in mathematics, United College, University of St Andrews; Capt H K Salvesen, shipowner, Edinburgh, formerly fellow of New College, Oxford, 1923-28, and lecturer in economics, Dr M S. Thomson, physician for diseases of the skin, King's College Hospital, Belgrave Hospital for Children, London Dr. J Weir, lecturer in palæontology, University of Glasgow, Mr W Whyte, cashier and general manager, Royal Bank of Scotland, Edinburgh, Dr W P D Wightman, science master, Edinburgh Academy, Prof B M Wilson, Department of Mathematics, University of St Andrews (University College, Dundee); Dr A Winstanley, engineer to Safety in Mines Research Board, Edinburgh

Sir James Jeans. President of the British Association

ON account of the lamented death of Sir William Hardy, it became necessary to elect a new president of the British Association for the meeting to be held at Aberdeen in September next The General Committee of the Association, which met for this purpose on Friday, March 2, elected Sir James Jeans to this office, and we understand that he has accepted the invitation to serve It is scarcely too much to say that no man of science now living is better known than he is to intelligent readers—both scientific and lay—through his brilliant expositions of complicated physical and mathematical conceptions These rare qualities have enabled him to open new realms of thought and inquiry to philosophers as well as experimentalists, and also to interest laymen in the development of ideas relating to the universe These involve explanations of relativity, quantum and wave mechanics and other novel aspects of cosmogony with their philosophical implications In literary style and scientific substance these works are among the best of their type ever produced, and their widespread circulation is a gratifying sign of public interest in intricate scientific subjects when made intelligible by artistic expression. What renders Sir James Jeans unique, however, is that he should possess this gift and at the same time be a leading authority in the field of mathematical physics and the author of those substantial contributions to the dynamical theory of gases and the mathematical theory of electricity and magnetism and dynamical astronomy, which led to his election into the Royal Society in 1906 and the award of a Royal medal in 1919. We may confidently anticipate that his presidential address to the British Association will enrich the literature of science and be worthy of the intellectual outlook of the great university and city in which it will be delivered.

Dr. H Moore

DR HAROLD MOORE, who has just taken office as president of the Institute of Metals, was born in 1878, and began his metallurgical career as a pupil of the late Dr. J E Stead In 1901 he became research metallurgist at the Parkhead steel works of William Beardmore and Co , Ltd., where his work in connexion with the manufacture and heat-treatment of armour-plate developed his interest in alloy steels Rapid progress was then being made in the application of nickel-chromium steels for this and other purposes Later work has shown that some of the methods of heat-treatment then developed empirically must have had the effect of suppressing temper brittleness, a trouble that was not clearly defined until some years later In 1904 Dr. Moore joined, as chief metallurgist, the Research Department at Woolwich Arsenal, where he remained for twenty-eight years, from 1919 until 1932, being director of metallurgical research As chief metallurgical adviser for many years to the War Office and the Ordnance Department of the Admiralty, Dr Moore had a wide experience of Service problems both on the manufacturing and the applications sides In 1922 a research on the casting of brass ingots was undertaken under his direction for the British Non Ferrous Metals Research Association, and this led to a gradually increasing co-operation between the Association and the Research Department, Woolwich, which undertook work on lead cable sheathing (in the course of which the widely used B N F ternary alloys of lead were developed), electrodeposition of nickel, tin coatings, etc In 1932 Dr Moore accepted the offer of the post of director of the British Non-Ferrous Metals Research Association, which had become vacant through the election of Dr R S Hutton as Goldsmith's professor of metallurgy in the University of Cambridge

Prof. William Buckland, 1784-1856

MARCH 12 marks the one hundred and fiftieth anniversary of the birth of the Rev William Buckland, geologist and father of the famous naturalist, Frank Buckland William Buckland was born at Tiverton, Devonshire, on March 12, 1784 He went up to Corpus Christi College, Oxford, from Winchester in 1801 and was elected a fellow of his College in 1808 Five years later he was appointed Oxford reader in mineralogy and was elected a fellow of the Geological Society, of which body he was twice president He was elected a fellow of the Royal Society in 1818, in which year he was appointed first professor of geology at Oxford. Upon the discovery of the Kirkdale Cave, Pickering, Yorkshire, in 1821, in which the fossil bones of numerous Tertiary animals were found, Buckland made a careful examination, and in 1822 the Royal Society awarded him its Copley medal for his account of the study of the remains found in the cave In 1823 he supplemented his observations on Kirkdale Cave by publishing "Reliquiæ Diluvianæ". A century ago he was working at his well-known Bridgewater Treatise (awarded for an essay "On the power, wisdom, and goodness of God, as manifested in the creation"), "Geology and Mineralogy considered with reference to Natural Theology", which was published in 1836 After his appointment as Canon of Christ Church in 1825, he lived at the House for twenty years, and it was in a wall in the Canon's garden that he tested the power of toads to live when immured in rock cavities In 1845 he was made Dean of Westminster. The strain of his new work at Westminster undoubtedly shortened his life, and he died and was buried at Islip in August 1856

Research on Influenza

THE extermination of the polecat in Great Britain was carried out with deplorable success in the eighteenth and early nineteenth centuries It is fortunate for the progress of knowledge that it survived in the domesticated form of the ferret, which was of immense service in solving the problem of the cause and prevention of dog distemper, and now promises to be of equal value in studying human influenza The facts so far ascertained at the National Institute for Medical Research at Hampstead are not conclusive but they are certainly very suggestive Dr P P Laidlaw, Dr C H Andrewes and Dr W Smith have found that washings from the noses of human cases of influenza, after passing through a bacteria proof filter, cause a characteristic febrile and catarrhal attack when instilled into the noses of ferrets, which by similar means can be carried on to other ferrets in series No other animal which has been tried is susceptible in the same way, and no other method of inoculation will infect the ferret—so much does progress rest on technique Recovered ferrets are immune and their blood will neutralise the infective material, as will the blood of human beings who have passed through an attack The facts fit in well with the idea that uncomplicated human influenza is relatively a trivial disease and that when the cyclical epidemics fall in the summer months they attract no great attention if they come in the winter they give a severe affection with a substantial mortality due to the secondary invasion of the lungs by Pfeiffer's bacillus, streptococci and perhaps pneumococci In the 'influenza' of pigs studied by Shope in America, the virus causing the primary disease is of practical importance only because it allows infection by the secondary bacillus

Petrol from Coal

THE liquid products of the carbonisation of coal at low temperatures have been disappointing because they lack the chemical characteristics which give special value to high temperature products Thus, low temperature tar oils have had to be used as boiler fuel oils—which is the lowest use to which a manufactured oil can be put It is, however, satisfactory to know that the Admiralty has been able to use such oils as fuel and thus satisfy its needs from British coal Researches now proceeding may provide new outlets for low temperature oils. As a source of motor spirit, low temperature products are also at a disadvantage, the crude spirit being troublesome to refine owing to a high proportion of unsaturated compounds liable to form gums on the engine. Moreover, the spirit, when refined, lacks the aromatic compounds which give to benzole its high 'anti-knock' value. The necessity for removing the unsaturated compounds is regrettable because they also possess 'anti-knock' qualities. Modern methods of refining benzole permit the retention of the unsaturated compounds while inhibiting their tendency to form gums. It is noteworthy that the spirit produced in the manufacture of coalite has given such satisfaction in use by a squadron of the Royal Air Force that, according to the *Times* of March 1, the Air Ministry has awarded a new contract for this spirit to cover the requirements of seven squadrons.

24-Hour Time System

WE are glad that the subject of the 24-hour system of time reckoning has again been raised in the House of Commons. In a written reply on March 5 to a question asked by Sir Arnold Wilson, the Postmaster-General stated: 'I understand that the British Broadcasting Corporation intend at an early date to adopt the 24-hour system of expressing time for general use and on an experimental basis. This will afford an opportunity for testing the attitude of public opinion, and I propose therefore to await the result of the experiment before coming to a decision."

University of Durham

THE Prime Minister announced in the House of Commons on March 6 that a Royal Commission has been appointed to inquire into the affairs of the University of Durham and its constituent colleges. Its terms of reference are :—"To inquire into the organization and work of the University and its three constituent colleges and into the relation of the University to those colleges, and to report in what respects the present organization can be improved and what changes, if any, are desirable in the constitutions, functions, and powers of the University and its three constituent colleges." The members of the Commission are Lord Moyne (chairman), Countess Grey, Sir Ross Barker, Major A. G. Church, Dr. H. R. Dean, the Rev. F. Homes Dudden, Dr. T. F. Sibly, and Mr. W. Spens.

Research in Engineering

IN his Friday evening discourse delivered at the Royal Institution on March 2, on "Some Current Research Problems in Engineering", Dr. H. J. Gough, superintendent of the Engineering Department of the National Physical Laboratory, described the main group of researches in progress in his department. As representative examples, researches on wind pressure on structures, impact forces between vehicles and the road and failure of metals in relation to crystalline structure were discussed and demonstrated. An investigation of the wind pressures acting on a shed, 100 ft. by 42 ft. by 33 ft., was described, air flow conditions being rendered visible by using a small wind tunnel and models of buildings in conjunction with an optical system employing the *Schlieren* method. An interesting feature of the investigation was the existence of dangerous suction effects tending to lift off roofs and suck out leeward walls. The importance in engineering service of the particularly dangerous and insidious type of failure known as 'fatigue' was discussed; the problem is also one of considerable scientific interest as it affords a convenient line of attack upon the general problem of the cohesion of matter. The use of large metallic single crystals has opened up a new field of study on both the practical and scientific aspects of fatigue. Fatigue in ductile metals is closely bound up with the effects of plastic distortion, or 'slip', upon the crystalline structure of these metals. The normal form of metals—consisting of crystals of varying orientations each composed of definite arrangements of atoms—was briefly described and the general and particular mechanisms of slip were demonstrated, employing lattice and other models. The effect of slip upon the actual crystalline structure, as deduced from X-ray data, was discussed, reference being made to 'crystal break-up' and lattice distortion, in relation to hardening. A tentative explanation of the cause and location of the initiation of fatigue cracks was described.

IN addition to the demonstrations given during Dr. Gough's discourse, exhibits relating to other researches in progress in the Engineering Department of the National Physical Laboratory were on view in the Royal Institution Library. The effect of the conditions of the surface on such engineering components as wrought iron chain, springs for vehicles, etc., is often of considerable influence on the resistance to impact loading or to repeated cyclical loading. In investigating the latter effect, a machine for applying cycles of torsional stresses was shown at work; this machine also demonstrates that quasi-elasticity is exhibited by materials even when subjected to repetitions of a range of stress which will *not* lead to fracture. Characteristic examples of fatigue failure in engineering service were exhibited, and the first high speed machine for investigating the behaviour of metals under combined fatigue stresses was shown in operation. Another machine demonstrated the characteristics of film lubrication between surfaces undergoing relative reciprocating motion; the coefficient of friction is independent of load but varies with speed and temperature, hence the friction is not of the true boundary type but relates to a thicker film. The skidding characteristics of road vehicles were demonstrated by models showing that: (*a*) with locked rear wheels the vehicle turns round while, if the front wheels are locked, the path of the vehicle is straight; (*b*) the turning effect arising from locked back wheels is caused by lack of directional control at the rear of the vehicle; (*c*) 'steering into the skid' tends to preserve a straight path; also, that over-correcting or delay leads to a series of swerves; (*d*) equal breaking on all four wheels can result in rotation of the vehicle and may be dangerous.

Elements Old and New

THE historical development of the conceptions of 'atom' and 'element' were outlined by Prof. James

Kendall, professor of chemistry in the University of Edinburgh, in delivering the twenty-fifth Bedson lecture in Newcastle-upon-Tyne on March 2. He pointed out that there have been four great periods of chemical discovery, corresponding quaintly with the four 'elements' of the Greeks, fire, air, earth, and water. The first was the phlogistic period, ending with Lavoisier; the second, the great period of research on gases; the third, the gradual rounding off of the chemistry of the rare earths; and the last opened up by the discovery of heavy water. It was mentioned that there should be nine kinds of water, and more than a hundred varieties of ethyl alcohol "some perhaps more exhilarating". Of great interest was the account of a research just concluded in the Edinburgh laboratories in which calcium from a mineral rich in potassium has been shown to have a slightly higher atomic weight owing to the isotope derived from the radioactive isotope of potassium, K^{41}. *This has been confirmed by Allison in the* United States, using his magneto-optic method. Two pegmatites of very different ages, but of which the younger contains much less calcium than the older, have indicated a half life period of 9×10^{11} years for potassium in agreement with one of two measurements by direct physical methods. The lecture was enlivened by numerous amusing reminiscences and suggestions, especially concerning the new element D (or, according to Prof. H. E. Armstrong, Ww!)

Institute of Chemistry

AT the fifty-sixth annual general meeting of the Institute of Chemistry held on March 1, the president, Prof. Jocelyn Thorpe, in moving the adoption of the annual report of Council, said that the register of the Institute contains the names of 6,176 fellows and associates, and more than 750 students. The number of members known to be disengaged is not more than 3 per cent, so that the profession does not appear to be seriously overcrowded. Rather than endeavouring to restrict entrance to the professions generally, he believes in insistence on a high standard of entrance examinations to the universities and colleges in order to eliminate those who are not likely to make really good professional material. The Legal and Parliamentary Committee, under the chairmanship of Sir Christopher Clayton, has rendered useful assistance in matters of public importance in which the profession was concerned. The new Pharmacy and Poisons Act has placed beyond doubt the right of those who practise chemistry, as well as those who practise pharmacy, to use the title 'chemist'. The examinations for National Certificates in Chemistry, conducted jointly by the Institute and the Board of Education and the Scottish Education Department respectively, are having a beneficial effect on the training in science afforded in technical institutions throughout the country. Lately, the Council has discussed the place of chemistry in general education. It seems that in some places chemistry is regarded as too difficult a subject for boys less than sixteen years of age, and that physics and biology should be given the preference as school subjects; the Council proposes to publish the discussion and to invite members to express their views thereon. Prof. Thorpe was re-elected president of the Institute.

Associated Learned Societies of Liverpool and District

AN important stage in the history of amateur scientific circles on Merseyside was a reception at the University of Liverpool on March 3 of the Associated Learned Societies of Liverpool and District, which represents some twenty amateur societies with a membership of about 4,000. The Vice-Chancellor of the University, Dr. H. J. W. Hetherington, who is also president of the Associated Societies, welcomed the gathering, while the Pro-Chancellor of the University, Mr. C. Sydney Jones, said the University is always to be looked upon as a friend and encourager of the amateur scientific bodies of Liverpool. The chairman of the Associated Societies, Mr. W. Mansbridge, in passing a vote of thanks, told how in the past the co-operation of amateur and professional scientific workers that existed in the societies has been to the benefit of each, and the societies have often been of help to the research workers at the University. A tour was then made of the various departments, where exhibits and demonstrations had been arranged. The Associated Learned Societies of Liverpool and District was formed in 1922 to promote co-operative undertakings between the various learned societies, to stimulate the interchange of ideas to the benefit of the societies or of knowledge, and to promote cordial relations between them and the University, the local education authorities and the municipal institutions. The committee has, in the past, arranged a number of joint *soirées* and scientific exhibitions, lectures and excursions to places of scientific interest.

The Autodial for Telephones

TELEPHONE subscribers connected to automatic exchanges who use their instruments frequently will soon be able to obviate in many cases the necessity of making the dialling operations. On the London automatic exchanges, the ordinary number of operations to be carried out is seven. By means of the new autodial, these operations can be reduced to two. The device is contained in a small box on the face of which there is an index of the names of the subscribers most frequently called. When anyone whose name is on this index has to be called, all that has to be done is to set the pointer of the instrument opposite the name required and depress a lever. There is no change-over switch and the instrument does not in the least interfere with the normal use of the telephone. Any number not on the index can be called by the usual method of dialling. The index names correspond with toothed discs, the teeth of which are cut away to form a transmitting code of impulses corresponding to the number selected. The discs clip on to a rotating cylinder so that the combination can be easily changed when necessary. The depression of the lever winds the cylinder sufficiently for one revolution and this is sufficient to generate the train of impulses necessary for completing the call. We understand that subscribers will be able to hire an autodial for a few shillings quarterly It is made either for 25 or 50 names For business houses and intercommunication systems, special forms are made The distribution of the instruments for private installations is made by Dictograph Telephones Ltd , Aurelia Road, Croydon.

Life on the Planets

IT is highly unlikely that there is any life on any planet in the solar system except the earth Dr W. S. Adams, who has himself made some spectroscopic investigations of our fellow planets, has enumerated the factors which preclude the possibility of life on each of them (Science Service, Washington, D C) In the case of Mercury, the planet is too hot and too small to hold an atmosphere Venus has neither oxygen nor water above the dense clouds which hide its surface, but it does have carbon dioxide, which shows that plants, if any, are not numerous The possibility of life is least remote in the case of this planet, but without plant life there can be no animals or human beings. Mars is so small, and its gravity so weak, that its atmosphere is thin It has polar caps suggesting water, but the spectrum shows no free oxygen. The outer planets have temperatures far below zero their great masses enable them to hold dense atmospheres, containing gases which are rare in the earth's atmosphere the poisonous gas ammonia is a fairly abundant constituent of their atmospheres, but oxygen has not been found in any of them Imaginative enthusiasts who project interplanetary journeys in rockets, must envisage a complete departure from the solar system, and conduct an extensive search among the satellites—if any—of some of the nearer stars, if they wish to find a landing place at which they can avoid suffocation at the end of their journey

British Spas and Health Resorts

WE have received the 1934 edition of the official handbook of the British Health Resorts Association, edited by Dr R Fortescue Fox ("British Spas, Inland and Seaside Resorts". London Messrs J. and A Churchill 1*s*. 0*d* net) The book has expanded and contains several new features The section on spa treatment and particulars of British spas has been extended, and health attractions of New Zealand, South Africa and Canada are detailed. Full information is also given respecting seaside resorts, and of the medical values of some of them as winter resorts for convalescents and delicate persons, and a full guide to hotels, hydros, etc , is included The Minister of Health, Sir E Hilton Young, contributes a foreword

Announcements

SIR HENRY GEORGE LYONS, lately director of the Science Museum, South Kensington, has been appointed a Trustee of the National Portrait Gallery, in succession to the late Sir William Hardy

MR. H T TIZARD, rector of the Imperial College of Science and Technology, has been appointed to be one of the Development Commissioners.

THE following appointments in the Colonial Agricultural Service have been made by the Secretary of State for the Colonies Mr. L L. De Verteuil, to be assistant agricultural officer, Antigua ; Mr S M Gilbert, assistant director of Agriculture, Trinidad, to be chief scientific officer, Coffee Research and Experimental Station, Tanganyika ; Mr R O Williams, economic botanist, to be assistant director of agriculture, Trinidad

THE Council of the Royal Society of Edinburgh has made the following awards Keith prize for the period 1931–33, to Dr A Crichton Mitchell, for his paper on "The Diurnal Incidence of Disturbance in the Terrestrial Magnetic Field" published in the *Transactions* within the period of the award ; Neill prize for the period 1931 33, to Dr G W Tyrrell, for his contributions to the geology and petrology of sub-arctic and sub-antarctic lands These prizes will be presented on July 2

IT is reported in the *Moscow Daily News* that a conference is to be held in Leningrad in April at which the study of the stratosphere is to be discussed It is anticipated that some 350 scientific workers will attend this conference, including Profs Joffe, Vavilov, Molchanov and the crew of the stratostat *USSR* It is stated that the Geophysical Observatory has issued a symposium on the first Soviet flight into the stratosphere summarising the scientific material obtained

A USEFUL bibliographical list of geographical books both for university and school use has been issued by Messrs W Heffer and Sons, Cambridge (Catalogue No 422). It contains more than 700 entries classified under various headings for easy reference Now as well as relatively old but standard works are included The list should prove useful to all students of the subject

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A woman lecturer in needlework, hygiene and household science at Bingley Training College—The Education Officer, County Hall, Wakefield, Yorkshire (March 13) Mechanical and automobile engineers in the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W 1 (March 15) A district live stock officer and an assistant marketing officer in the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S W.1 (March 19) An electrical inspector of factories—The Industrial Division, Home Office, London, S W 1 (March 20) A resident lecturer in science, chiefly biology and gardening, at St Hild's College, Durham—The Principal (March 28) Examiners in various subjects of the Matriculation and General School Examination of the University of London—The Secretary to the Matriculation and School Examinations Council, University of London, South Kensington, S W 7 (April 4) Professors of medicine and pathology at the British Post-Graduate Medical School—The Academic Registrar, University of London, South Kensington, S.W 7 (May 4)

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Reviews

The Scientific Spirit of the Greeks

The Heroic Age of Science the Conception, Ideals and Methods of Science among the Ancient Greeks By Prof William Arthur Heidel (Published for the Carnegie Institution of Washington) Pp vii+203 (Baltimore, Md The Williams and Wilkins Co ; London Baillière, Tindall and Cox, 1933) 12*s* 6*d*

"WE must endeavour," wrote Plato in the "Timæus", "to construct the four forms of bodies which excel in beauty, and then we shall be able to say that we have sufficiently apprehended their nature " To wrest this sentence from its context, and to take it as a characteristic expression of a prominent aspect of Greek science, is to do no great violence to truth The modern conception of science scarcely becomes recognisable until the days of Galileo, and in any judgment of early science we should remember that our present standards of sufficient apprehension of the nature of a body do not necessarily apply That we believe them to be better is not strictly relevant , the essential factor in judgment must be . given the contemporary standards, what results might have been expected, and what were actually achieved ?

There are certain problems that the world seems inevitably to present to the thinking man For some centuries past, it has been the custom—a custom justified by its success—to attack these problems piecemeal rather than by a grand general onslaught An initial slowness of advance gradually changed to rapid progress, and we now have a body of well-established knowledge unparalleled in the history of the race The ancient Greek was of too fiery an intellectual spirit to wait for the patient accumulation of facts , he took such meagre stock as was available, supplemented it by an acute power of observation, and proceeded with unconquerable enthusiasm to the sufficient apprehension of himself, the earth and the heavenly bodies.

It was a necessary consequence of this uncontrollable burgeoning of the mind that the problems we now segregate into theology, philosophy, science, mathematics and other conventional folds should be fused by the Greek into a single mass , and if the mass appears to us to be of a terrifying heterogeneity, we are not to suppose that it so presented itself to him On the contrary, if Greece has one lesson more than another for modern science, it is that devotion to analysis should not lead to neglect of the synthetic outlook that, in Athens, extracted such brilliant results from such scanty material

In an age when the principal intellectual aim was to solve the universe to-day, or at latest to-morrow, we must not expect to find a humdrum corpus of scientific knowledge increasing by imperceptible degrees, but steadily As Prof Heidel justly remarks, in the epilogue to his valuable and extremely interesting book, the Greek "seems to have felt, as did Wordsworth, that 'the world is too much with us' , its very jostlings gave him a sense of being an alien until he could, as it were, keep it at arm's length long enough to glimpse its meaning Its significance and relations fascinated him—if he could discover these, the brute facts interested him little" It was this imperious passion to unriddle the major enigmas that gave Greek thought both its sublime successes and its gravest shortcomings

Among the latter, a general failure to appreciate the vital importance of experiment is that which the modern man of science will most condemn There is a remarkable unanimity of historians (a body not commonly given to speak with one voice) that the art of experiment, though by no means unborn at that time, was despised rather than encouraged by the educated Greek , and it is certainly true that even Aristotle relates many things as facts that he might easily have disproved by the simplest of experiments It is not that powers of observation were lacking—indeed, few peoples have equalled the Greeks in keenness and accuracy of observation—but that the deliberate arrangement of events for the purpose of defining or extending knowledge appears to have been regarded by them as too slow, too cumbersome or too undignified a method for the intelligent man.

Let the craftsman, the artisan, the slave, deal manually with reluctant matter, while the philosopher employs his time to better advantage with the things of the mind

Prof Heidel has much to say that is new and illuminating upon this verdict He makes the point that, in evidential value, as in principle, there is no reason for giving experiment the preference over observation, and that in some sciences, which are (or may be) quite as exact as the experimental, there is little or no possibility of experimenting "What distinguishes the best scientific procedure of modern times," he says, "is chiefly the refinement of technique, and, in a few outstanding sciences, the recognition of the methodological principles which require an elaborate technique This refinement of technique is due principally to the progressive definition of problems as science has pushed its inquiries farther and farther" While this point of view might be disputed, and while Prof Heidel might be reminded that even astronomy is, in numerous and important respects, an experimental science, we may readily grant him the conclusion he wishes next to draw, namely, that since the Greeks were pioneers, we ought not to expect the same refinement of experiment from them that we demand of modern science

The conclusion is a weighty one, and not the less so for becoming self-evident when thus baldly stated We are made to reflect that, far from being a ready-made tool, the art of experimentation had to be chipped and hewn for long ages before reaching its present Saladin-sword efficiency Our former question recurs What were the contemporary standards, and what relation do the results bear to what might have been achieved ? Prof Heidel shows us that the standards were necessarily low, and that the results were in fact by no means so negligible as is popularly supposed He is able to quote many genuine experiments from Greek authors, and to bring forward evidence that the basic nature of experiment, and its importance, were widely recognised He admits that for the most part such experiments as were made were simple, and served to answer simple questions, and that apparently they were generally undertaken to test theories rather than to discover facts upon which to found theories But he has certainly established the thesis that, within limits, the Greeks knew how to experiment and appreciated the confirmation which a successful experiment provided. Since, moreover, he does not overstate his case, but frankly agrees that there is a great difference between modern science and the achievements of the Greeks, we may the more happily revise our estimate of the 'heroic age of science', and admit a greater debt to Hellas than we had previously acknowledged

In his preface, Prof Heidel says that he hopes to make further contributions to the history of Greek science in various fields That hope will be echoed heartily by all who have the good fortune to read the present volume E J HOLMYARD

The Thyroid Gland

The Thyroid Gland its Chemistry and Physiology By Prof Charles Robert Harington Pp xiii + 222 + 8 plates (London Oxford University Press, 1933) 15*s* net

THERE will be few more interesting chapters in the history of science than that which includes the development of our knowledge of the chemistry and physiology of the thyroid gland Prof Harington's book offers an excellent basis for that chapter He reviews early conceptions of the nature of thyroid function, the gradual definition of ideas through the study of myxœdema, operative and experimental removal of the gland, and replacement therapy, to Magnus Levy's demonstrations in 1895 of the characteristic effect of the thyroid on metabolism

The concurrent story of the study of goitre is outlined from the earliest records to the present day The curious persistence throughout the story, from Pliny, about 2000 years ago to the present time, of certain tendencies, for example to associate goitre with certain drinking waters, is of great interest Geographical, and age and sex, distribution, are discussed in relation both to older theories and to more modern knowledge The inspired attempt of Chatin, early in last century, to correlate the incidence of goitre with low iodine supply, without any idea that iodine is an essential constituent of the gland secretion, has been amply justified by recent work

The chemical study of the thyroid secretion and the exact study of its metabolic action date from much more recent times and follow the discovery of iodine in the thyroid The preliminary studies showed that "the organic iodine compound is attached to a characteristic globulin which, together with a small proportion of an iodine-free nucleo-albumin, constitutes the colloid with which the follicles of the normal thyroid are filled". From there, the account is of work done by Prof. Harington and his collaborators They have shown that the iodine in the thyroid is divided between diiodotyrosine and the characteristic thyroid amino-acid, thyroxine, the former being regarded as precursor of the latter. Thyroxine exerts all the effects on metabolism of thyroglobulin but, on the basis of equivalent iodine content, in less degree. It is further shown that a peptide containing thyroxine as one of the constituent amino-acids, isolated from thyroglobulin by enzymic digestion, is more active than thyroxine alone Prof Harington believes, therefore, that such a compound, possibly one more complex and more active than that isolated, represents the true active principle.

On the physiology side the book is perhaps somewhat less satisfying than on the chemical While it will possibly be agreed that "the immediate cause of goitre is failure of the thyroid gland to obtain an adequate supply of iodine", it is doubtful whether it will also be accepted as settled that "environmental deficiency is the sole cause of most endemic goitre" It seems possible, assessing all the available evidence, that the deficiency, in many cases, may be not primary but conditioned by a multiplicity of factors It would be of great, and not purely academic, interest to find a satisfactory explanation for the persistent popular association of goitre with water or with lime Such beliefs may be as well founded as the ancient use of burnt sponge as a remedy But the water belief cannot yet be shown to bear any relationship to the iodine deficiency theory.

There are other questions, too, that might be asked If the dysthyroidism theory of Graves' disease, as enunciated by Plummer, be rejected on the basis that "no derivative of thyroxine containing less than the full complement of iodine either approximates to thyroxine in activity or exhibits any toxic properties whatever", may it not immediately be reformulated on the basis of Prof. Harington's own statement that "variations may occur in the amino-acids with which thyroxine is combined to form the active secretion, so that the physiological properties of the secretion produced by different glands and under different conditions may not be quantitatively constant" ?

Prof. Harington contends that there is reason to seek the origin of the "thyroid diarrhœa" of Graves' disease outside the gland itself. Anterior pituitary, with its recently discovered thyrotropic hormone, offers itself as an obvious scapegoat at the moment. But then there is the question of whether abnormality of the pituitary is, in fact, associated with Graves' disease The riddle is still to read Those who are interested will find in this book the fundamental chemical and physiological facts with which any theory of Graves' disease must conform

I LEITCH.

Human Reproduction

The Science of Human Reproduction Biological Aspects of Sex By Prof H M Parshley Pp 319 (London George Allen and Unwin, Ltd, 1933) 12*s* 6*d* net

THE author of this book is an American professor of zoology, and from his preface we learn that a large proportion of the population (of the United States ?) refuse to accept religious guidance in sexual matters, and that he aspires to substitute for this guidance the supreme authority of science He has succeeded in giving a readable account couched in comparatively simple language of the structure of the reproductive organs in man, which should be quite intelligible to the average educated person

A very interesting point is the author's explanation of how at the same time the ova are wafted *down* the Fallopian tube and the sperm propelled up it Parker's investigations (published in the *Phil Trans Roy Soc*) seem to show that spermatozoa are quite incapable of such a feat as swimming upwards in the face of a down-flowing current. Apparently they adhere to the walls of the tube, swimming slowly in all directions, and are carried upwards in folds of the wall by an upwardly directed peristalsis The ova, on the contrary, lie free in the lumen and are carried downwards by the current produced by the cilia lining the walls

Like many Americans, the author is a whole-hearted supporter of the Morgan theory of the determination of sex by the 'random' passage of sex-chromosomes into one cell or another. This theory, so facile and at first sight so plausible (especially when represented by simplified diagrams in which all awkward details are left out), threatens to become a dogma in the United States. Yet a wide survey of the animal kingdom shows it to be radically false Sex, one of the most fundamental phenomena of life, must be essentially the same thing wherever it occurs. As a matter of fact, the eggs and spermatozoa of sponges, the lowest

Metazoa, are not very different in their histology from those of man, the highest. There are, however, very many cases where sex is 'determined' entirely independently of any possible intervention by sex-chromosomes In the bee, for example, the male possesses all the kinds of chromosome which are present in the female but they are haploid in the male and diploid in the female In *Rana esculenta*, the edible frog of northern Europe, a large proportion of the tadpoles metamorphose into young females, but of these nearly half change into males during the period of their adolescence, which lasts four years They develop seminal tubes from the peritoneal covering of the ovary, which grow into the ovary and completely destroy it, replacing it by a testes Then there is the classical case of Prof Crew's aged hen the ovary of which was attacked by tuberculosis, and as a result the animal became a cock and produced viable spermatozoa It seems clear that there are fundamentally opposed male and female constitutions, but that the constitution of every individual is a mixture of the two, and that the structural manifestations of sex depend on the proportion of these constitutions and on which gains the upper hand in development

When the author approaches the vital subject of sexual behaviour, he makes some very sensible remarks on birth-control and the necessity of regulating the population But in dealing with eugenics he is less happy He arrives at the conclusion that the object to be aimed at is not the breeding of intellectual men (there might be too many of them and they might become discontented with the positions available for them) but of good men, and that goodness is a heritable quality ! He points out that human sexual behaviour both normal and abnormal presents many analogies with the sexual actions of the higher primates and the same fundamental 'urges' are common to both Here he relies on the work of Dr. S Zuckerman on the sexual life of baboons Zuckerman was until recently prosector of the Zoological Society of London and his work is based on observations on the "Monkey Hill" in the Zoological Gardens and on knowledge gleaned during a six months' tour in Africa Some who, like the reviewer, have had long periods of service on the Council of the Society will not agree with the author and Dr Zuckerman that the ecology of Monkey Hill presents a fair copy of the natural conditions under which these apes live

When we further consider the amendments which the author suggests to the old code of morals prescribed by the "taboos of religion", such as the recognition of sexual promiscuity before marriage, and the permission (to the male) of a certain amount of promiscuity after it, we are enabled in some measure to understand the rise and progress of 'Fundamentalism' in the United States

E W MacBride

Agricultural Organisation

The Planning of Agriculture By Viscount Astor and Keith A H Murray Pp xvii + 186 (London Oxford University Press, 1933) 6s net

BRITISH agriculture is unquestionably in a very serious position, and few will disagree with the assertion of the farmers that they are not mainly to blame The essential features of farming that mark it off from other industries are that its programme of production must be definitely settled many months ahead, that the programme, once begun, cannot be modified, and that the amount of production is subject to large and uncontrollable fluctuations from one season to the next In the past few years, these inherent difficulties have been intensified by the rapid fall of prices due to world economic conditions and by the numerous corollaries of that fall It is no longer possible for the landlord to act as a buffer between his tenant farmers and their difficulties, and the State has, of necessity, taken over a portion of this task

State-aid inevitably implies some measure of control by the State The development of the quota system is, presumably, regarded by the authorities as the best way of providing assistance without unduly restricting the initiative and freedom of action of the farmers Viscount Astor and Dr Murray criticise this policy on both agricultural and economic grounds They believe that the future of British farming lies in live-stock, fruit, and vegetables, and feel that the present policy will slow up the change-over to these branches of farming, and is therefore to be avoided They consider that any protection needed by this industry is better given by tariffs, since they are capable of rapid adjustments when necessary; further, tariffs bring in revenue that can, if circumstances necessitate, be distributed to the home farmer as a subsidy or bounty. Finally, quotas, in their opinion, tend to 'canalise' trade to an excessive degree, since some form of bottle-neck organisation is necessary if they are to be worked successfully

Economists are in too many camps nowadays for these views to find universal acceptance The system under which the production of the nations of the world was complementary has, in the opinion of some thinkers, been ended by the discoveries of science and the development of nationalism If the nations are becoming less interdependent economically, the old methods of trading and of financing trade can no longer apply unaltered The evolution of new methods will take some time and there are bound to be initial mistakes Whatever the policy finally adopted, it must take into account one feature of the present depression that distinguishes it from all previous ones its association with abundance—potential, if not actual Those who hold these views consider that the basic problem is how to use abundance to improve the lot of mankind instead of to menace them with recurring unemployment

B A K

Geography of Asia

The Continent of Asia By Prof Lionel W Lyde Pp xxii + 777 (London Macmillan and Co, Ltd, 1933) 16*s* net

ASIA covers one third of the land-surface of the globe, and half the world's population is packed into the Indo-Pacific hinterland, the territories between the Indus and the Amur An author attempting to sketch its bewildering varieties of relief, climate and natural resources, and, at the same time, to summarise coherently the effects of geographical control on its products and the activities of its peoples, must be equipped with an immense detailed knowledge and possess literary ability of an exceptional kind

Prof Lyde's earlier work—"The Continent of Europe"—displayed these essential qualifications and they are conspicuous again in the completion of this greater task The book is divided into "General" and "Regional" sections The former, occupying a quarter of the volume, contains the mature reflections of a lifetime on the relations of Asia with the rest of the world, on its orography, its eastern and western lobes and central portion Essays on climate as a whole and in its special aspects are followed by accounts of twelve climatic provinces, the classification being based on genetic control rather than precise statistics These lead naturally to surveys of the vegetation and faunas, of man and his Asiatic differentiations. A final chapter is entitled "Some Controls", and "control" is defined as "the tendency of certain geographical conditions to favour or disfavour certain human responses", while "response" itself may lead to action as well as reaction Amongst other subjects introduced here are the types of social polity which the continent presents on so grand a scale, and its curious deficiency, with few exceptions, in large deposits of those minerals on which European and North American civilisation largely rests

Into such a framework the regional chapters, dealing systematically, but in proper proportion, with each country, are skilfully fitted They have been revised periodically for twelve years before publication and they bear a corresponding finish which reflects the author's mind and its purposes Standardisation of treatment is avoided, the construction of each chapter being determined by the decisive human aspect of the unit concerned Thus though the ways of approaching each country may differ, they converge towards the same object, the correlation of the social, economic and political life of a people with the physical background of their environment and the vagaries of the climate in which they exist Russian Asia, the Lands of the Five Seas, the Anatolian Plateau, Mesopotamia, Syria and Palestine, Arabia, the Iranian Plateau, India, Ceylon, the Indo-Pacific Fan, China and its dependencies, Japan and Manchuria are so studied in turn, and it is unfortunate that a definition of a continent elastic enough to include Ceylon and Japan was not stretched across the South China Sea to embrace those other islands, often grouped together as the East Indies, as well This section is characterised throughout by a critical insight finding expression in incisive conclusions, which, particularly in matters of political geography, do not always coincide with other contemporary views

Short, selected references to literature are given, but those recommended in the case of India and mentioned on p 435 do not appear The book is illustrated with 143 maps and diagrams, and these together with the index, letterpress and binding leave nothing to be desired.

It would be very remarkable if an occasional slip in minor detail was not to be found in such an encyclopædic collection of facts, but they are rare and of little account, though the Shan plateau, crossed as it is by two railways and traversed in all directions by good motor roads and busy mule tracks, should not be described as "very imperfectly known" (p. 500)

The unique character of this important book should assure its systematic use in the geography schools and universities of both Western and Eastern lands. To a reader desiring enlightenment on the grave movements which disturb the whole of Asia to-day, from Kashgar to Colombo in one direction and from Mecca to Mukden in the other, it can be thoroughly recommended Finally, a place must be made for it at once in the front row of authoritative works of reference on Asiatic questions generally

J. Coggin Brown

The Coal Problem

(1) *Coal in the New Era.* By Ivor Thomas Pp 224. (London and New York . G P Putnam's Sons, 1934) 5*s.* net

(2) *Smoke and the Atmosphere · Studies from a Factory Town* By Dr J R Ashworth Pp xii + 131 (Manchester Manchester University Press, 1933) 7*s* 6*d.* net

MAN digs up certain black stones from the bosom of the earth and says to them, "Go forth and make heat, power, light, gas and electricity"

Modern civilisation has been largely built up on coal: the fall in the demand for coal is perhaps the most serious industrial problem with which Great Britain is faced. The reasons for the decline are numerous; they include industrial depression, more economic use of coal in industry, smaller domestic purchasing power, competition with foreign coal in export markets and with imported oil in the home markets. The coal question is a tragic example of mishandling; mistakes political, social, economic and technical, have been made of every kind. Even yet there is chaos where there should be order, in spite of repeated attempts by the State and by private bodies to help the industry to better days Raw coal regards gas and electricity as its enemies, and these two great industries are at each other's throats, instead of all three working for the common interests Each section is to-day undertaking costly propaganda on its own whereas they should be working together in the closest harmony. We are repeatedly told that a new era for coal and its products has arrived and that the raw coal sent to the pit-mouth is to be transformed into a variety of more useful and more valuable products, but though the disease has been diagnosed the doctors quarrel as to the remedy.

(1) Mr. Thomas, writing from the point of view of the intelligent man interested in scientific progress, has sought to set out the coal problem and its solutions. "Science to the Rescue" is his chapter heading, explained by such subsidiary titles as "From Pit to Petrol Tank" and "Gas as a Motor Fuel" He is right in his assumption that only science can save the coal industry, though with coal it requires far more than the usual eloquence and sincerity of the missionary to make converts to applying science There is, alas, too much human nature among the ingredients which go to make up the problem Mr Thomas has the courage to set out the political and financial aspects of the question, as well as to advocate the reconstruction of coal as a rationalised industry under a National Power Board His treatment of this question deserves thoughtful consideration, for it represents a growing opinion widely held among the younger generation

Individual capitalistic organisations of moderate size are on their trial, for they have generally failed to overcome post-War difficulties the idea of control of production by the State is growing in favour as countries grow more nationalistic, just as the great advantage of operating an industry as a unit of national size, with unified buying and central selling, is being recognised by many of the nationals

This is obviously a controversial subject but it is one well worth examining, the drift is undoubtedly in the direction indicated

The coal mining industry has many vexed questions to settle—including wages and royalties Its quota system finds few friends among the users, whose grumblings so far have been largely stilled for patriotic considerations, but the complaints of the excessive price charged to the gas industry should be noted This is making gas dearer than it otherwise need be and retarding the development of gas and the consequent elimination of smoke and dirt and fog from our cities. Far too many colliery managers consider that it is their sole duty to bring coal to the surface without any consideration of its quality or ultimate use Perhaps, however, we should remember, as Mr W. G. Gordon has reminded us recently, that a few years ago it was coal that the world wanted and that the utilisation of coal which we are all concerned with to-day is a comparatively new idea.

In consequence of its disorganisation, the returns of the coal industry are very inequitably distributed According to Mr. Thomas, whereas the miner gets 9*s* per ton for his arduous work, the ultimate seller of household coal, after deducting selling and delivery expenses, received 13*s* 9·94*d* in 1932

The more technical portion of the book is marred by a good many inaccuracies and over-statements, but these are minor blemishes in a work which should be widely read. For the future, Mr Thomas pins his faith on the use of coal to produce oil by hydrogenation, on the extension of low temperature carbonisation replacing raw coal, on the development of electricity, and on the use of gas as a motor fuel The amount used in industry, as locomotive fuel and on ships, is expected to diminish

(2) Dr Ashworth deals with another, though in our opinion anything but minor, aspect of the coal problem, the formation of smoke and soot in a manufacturing town—Rochdale—which is particularly unfortunate in this respect He has devised apparatus to measure various features of the evil, in particular the deposited impurities, the horizontal pollution and the suspended matter The hourly and other records taken over a period have enabled a number of interesting deductions to be drawn

Perhaps the most interesting of these has relation to the influence of smoke and hot gases from factory chimneys on rainfall, which is apparently less on Sundays, when the factories are not working, than on the other days of the week A very considerable amount of statistical evidence is cited in support of this conclusion Equally Monday has continuously high rainfall values from 6 a m until 3 p m , when the smoke emission due to starting up the factories is at its greatest In clean areas there is no such unequal distribution of the rainfall on particular days of the week

The influence of atmospheric pollution on light has also been studied, the iodine, methylene blue and photographic methods being carefully studied and compared Sunday being the cleanest day is also that of highest light intensity in Rochdale, whereas in Ventnor and even in London there is little or no difference between the various days of the week in light intensity. Rochdale has only an average light intensity per day of 0 5 compared with 1·6 for London and 6 3 for Ventnor The average deposit per month per square kilometre at Rochdale is 17·2 metric tons, which compares with a figure of 6·4 tons in a residential town like Cheltenham. It is estimated that more than 60 per cent of the total deposit in Rochdale is from factory chimneys.

It is most valuable to have careful records of this kind, and it is to be hoped that they will be collected in many centres Seeing that most of the smoke is preventable, and considering the harm its presence does to health and property, it is a striking indictment of our habit of accepting a state of affairs which no civilised body of men should tolerate

Somehow everything connected with coal has its dingy side in restless, grimy, utilitarian, man-made England E F. A.

Atomic Collisions

The Theory of Atomic Collisions By N. F Mott and Dr H S W Massey (The International Series of Monographs on Physics) Pp xv+283. (Oxford Clarendon Press , London Oxford University Press, 1933) 17*s* 6*d* net

THIS book gives a very complete account of the quantum theory of collisions In an introductory chapter, some theorems of wave mechanics are stated The following four chapters are devoted to such collisions in which the internal state of the colliding particles is not changed, even during the collision, that is, so to speak, collisions of rigid particles First of all, the general formula for the scattering by a central field of force is derived The case of a Coulomb field is discussed in greater detail Then a chapter on electron spin is included, in which great care has been taken to explain the peculiar spin-wave-functions Finally, the collision of two identical free particles and the important rôle of exchange therein is treated

The main part of the book deals with the collisions of electrons with atoms. The first chapter supplies the necessary mathematical tool, namely, the calculation of a solution of a given differential equation which represents an outgoing spherical wave As a special case, Born's approximation is derived The connexion of the exact formula for the scattering by a central field of force with the Born formula as well as with the classical theory is discussed Then a very valuable summary of the methods available for treating collisions with atoms is given, special attention being paid to the more complicated processes such as electron exchange, etc Afterwards, the various kinds of collisions are treated in detail For elastic collisions of fast electrons, Born's approximation can be applied, whereas for medium velocities the distortion of the electron wave by the field of the atom has to be taken into account In both cases the theory compares favourably with experiment, For slow electrons, however, the theory appears to be still far from complete, mainly because there is no approximation for the exchange effect which is sufficiently accurate and at the same time sufficiently easy to handle Even the conditions under which exchange becomes important are not yet exactly known

The theory of inelastic collisions of fast electrons with atoms appears to be almost complete The probability for excitation and ionisation of the atom, the stopping power, the angular distribution of scattered and ejected electrons, can be calculated from Born's method in accordance with experiment More of a qualitative nature are the theoretical predictions about the inelastic scattering of slow electrons by heavy atoms. The scattering of electrons by molecules can be calculated with fair accuracy by adding the scattering amplitudes from the constituent atoms The discussion of the various types of excitation, ionisation and dissociation occurring if a molecule is bombarded by electrons is very clear

Much has still to be done upon the collisions of two heavy particles such as atoms and molecules The book states many important questions, especially in the field of chemical kinetics, and gives the methods for treating them and the results obtained up to the present

The last two chapters deal with Dirac's method of variation of parameters, with the relativistic scattering formula and the calculation of the field of a nucleus from the anomalous scattering of α-particles

There is, we think, no collision problem of any importance which is not mentioned in the book, and for most of them at least a qualitative theory is given But it is of even more value that the book not only compiles the results and theoretical methods, but also points out clearly the conditions under which each method is applicable The standard of the book is rather high, and there are some sections that will appear not easy to read This is, however, only natural, because some of the collision problems, especially those involving slow particles, require rather complicated mathematics The development of the mathematical methods apart from the physical application will be found helpful It is of special value that many results of the authors hitherto unpublished are included in the book, elucidating points that have not been clear even to the expert

The book will, without doubt, be indispensable for everybody doing research on collisions either theoretical or experimental The experimentalist will draw much information from the great number of tables and figures representing the theoretical results Moreover, it will be of great interest to all those who, having a sound general knowledge of wave mechanics, wish to know more about this specially attractive application of it

H A Bethe

Electrical Measurements

(1) *High-Frequency Measurements* By August Hund (International Series in Physics) Pp xi+491. (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1933) 30s net

(2) *Advanced Electrical Measurements* By Dr William R Smythe and Dr Walter C Michels Pp x+240 (London Chapman and Hall, Ltd, 1933) 15s net

(1) THE casual reader may be surprised by the easy confidence with which the publishers imprint "First Edition" on the title page of this book But they are certainly justified, there can be no reasonable doubt that the work will run through many editions, for it is excellently done, and is very easily the best that has yet appeared on this complex subject It would be difficult to find any type of problem in high-frequency measurement which escapes mention This catholicity, indeed, brings with it one disadvantage which might well be corrected in a later edition the range of methods covered is so wide that critical comparison, on which the reader might base a choice of method, is insufficiently provided It would be genuinely helpful if the author would follow "Baedeker" and the "A A Handbook" in attaching stars to recommended methods

In the eighteen chapters of the book, the author deals, with a great deal of wisdom and helpful inter-relating comment, with the special technique of measurements at high frequency, giving special attention to the wide range of physical phenomena which must be kept in mind if the ultimate indication is to be truly interpreted in terms of the quantity to be measured The first chapter deals with fundamental relations and circuit properties, and the second with high-frequency sources and other useful laboratory apparatus. In the third the author quite illogically, but quite rightly, includes the measurement of minute direct currents in his discussion of measuring systems for high-frequency currents, later chapters deal with the measurement of voltage, frequency, capacitance, self-inductance, mutual inductance and coupling, effective resistance, high-frequency power and losses, decrement, power-factor, phase difference and sharpness of resonance, and ferromagnetic properties. A very satisfactory chapter on tube measurements deals with a wide range of thermionic tubes and associated circuits, and this is followed naturally by a chapter on modulation measurements.

Amongst the most valuable and novel sections of the work are the treatment of determinations on aerials and lines, and on wave propagation. On both these aspects of high-frequency measurement it has been extremely difficult for the student to find safe guides without a wide search of the literature. Should he require more information than can be compressed into these chapters, he will find the author's selection of references at once generous and judicious. The two remaining chapters deal with piezo-electric apparatus and with miscellaneous measurements and data.

The first edition of a work, by one man, on this heroic scale, cannot be free from minor blemishes. The language frequently has a flavour of incomplete translation from the German: the 'thermocross', the 'stoic metal', the 'step-over resonator', the 'space condenser' and the 'spacious pole' are unfamiliar and a little disturbing. There are occasional lapses from the generally high level of clarity, precision and care; the statement that "this alloy has a high temperature coefficient" comes to an untimely end before we have learned what property it is that varies so rapidly with temperature. Similarly "a sensitive galvanometer (10^{-10})" is mysterious. But these flaws, such misprints as those in the formulæ of pp. 22, 43, and 211, and the inadequate explanation of "bisymbolic multiplication" by mere reference to a paper of 1920 are amply offset by corresponding high peaks in the book. As typical peaks we may cite the matter of pp. 98, 103, 124, 131 and 230, and we may rejoice that on p. 185 the author has given the circuit values that are required to preserve the circuit diagram of a beat-frequency generator from being a snare and a delusion. The next edition will doubtless recognise the cathode ray oscillograph as a photographic recorder and not as a merely visual device. Meanwhile the first edition is a great work.

(2) Drs. Smythe and Michels have produced a useful handbook for the instructional laboratory, but the title which they have chosen is somewhat too wide for the scope of the work itself. The conventional methods for the measurement of resistance, current, potential difference, quantity of electricity, and magnetic properties are adequately discussed, without any revolutionary improvement in exposition over previously available works.

Measurements on vacuum tubes (that is, diodes to tetrodes) and on high-frequency circuits are treated in a summary and rudimentary way, while the chapters on alternating current work are likely to leave the student a good deal to unlearn on the relative merits of different devices. The remaining chapters, on electricity in gases, electrical thermometry, radiation measurements and electrochemical measurements are more useful than the others, because they are less readily found elsewhere.

Review of Physical Chemistry

(1) *Introduction to Physical Chemistry*. By Prof. Alexander Findlay. Pp. vii + 492. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 7*s*. 6*d*.

(2) *Recent Advances in Physical Chemistry*. By Dr. Samuel Glasstone. Second edition. Pp. viii + 498. (London: J. and A. Churchill, 1933.) 15*s*.

(1) PROF. FINDLAY'S book includes all that a student beginning the systematic study of physical chemistry requires, and is of such a standard that it can serve as an introduction to the more advanced parts of the subject, the references to the literature which are given also being very useful in the latter respect. The historical method is generally followed, yet in all parts the treatment is thoroughly modern, the recent developments of the subject being adequately dealt with. The mathematics required goes no further than the elements of the calculus, without which no progress can be made in the study of physical chemistry.

The book commences with a chapter o constitution of matter, including atomic numbers, isotopes, radioactivity and the electronic theory of valency. The following chapters deal with the properties of gases, liquids and crystalline solids, including crystal structure. The explanation of the Joule-Thomson effect on p. 56 requires modification, since a gas may obey Boyle's law and yet exhibit a Joule-Thomson effect. The study of dilute solutions follows, all the fundamental equations being deduced; and here, as in the rest of the book, an excellent feature is the adequate discussion of experimental methods and apparatus. This section includes electrolysis. Thermochemistry, homogeneous equilibrium, reaction velocity, catalysis and thermodynamics, including an elementary account of Nernst's theorem, follow The book then deals with strong electrolytes, activity, hydrogen ion exponent, hydrolysis, indicators, titrations and buffer solutions, and this part of the book is deserving of special commendation for the clearness of the treatment and the adequacy of the information conveyed in a reasonable space. In the thermochemical sections it would perhaps have been better if the author had used the modern abbreviations 'g cal' and 'k.cal' instead of 'cal.' and 'Cal', which sometimes lead to error.

The chapter on electromotive force is carefully written and comprehensive, although an example of the introduction of the equation for liquid junction potential in the case of an actual cell would have been useful, since this matter is one which often proves difficult to students, particularly in the signs The rest of the book contains chapters on photochemistry, heterogeneous equilibrium, the phase rule (which is illustrated by a very well-chosen set of examples), adsorption and the colloidal state A good collection of numerical and other exercises is given at the end of the book

Prof Findlay's book is an excellent introduction to its subject. Without suffering from the defect of many elementary works, that of being too sketchy and avoiding difficult matters, it is yet well within the comprehension of the student Anyone who masters the course provided will be well on the way to a sound knowledge of modern physical chemistry, and since this subject now has such important bearings on other sciences, the book should make an appeal to a wide field of users It is excellently produced and the price is very moderate

(2) Dr Glasstone's book, which has reached a second edition after two years, appeals to the more advanced student, who has already mastered the contents of such a book as the preceding After the fundamentals have been dealt with, the teacher or student is faced with a large field of more recent and more advanced work which it is impossible to cover in the part of the year generally devoted to advanced physical chemistry in university courses. Some selection is necessary and Dr Glasstone has made a popular choice of subjects

The first chapter deals with the structure of the atom and the modern theory of valency. In the new edition a section on wave mechanics appears, and although the treatment is extremely sketchy and on the lines of the "Annual Reports" of the Chemical Society, it may serve to give an idea of the possible meanings of expressions now used rather vaguely by some chemical authors Recent work on nuclear disintegration, the neutron and the positive electron is mentioned The chapter on the parachor illustrates the applications in the determination of structure The chapter on dipole moments has been extended to include an elementary treatment of rotation, that on molecular spectra now contains a discussion of potential energy curves, and as in the first edition also deals with the Raman effect Homogeneous gas reactions are dealt with in more detail, including a discussion of activation energy and reactions in solution The chapter on photochemistry has been improved by a fuller discussion of reaction mechanism Surface potentials are now dealt with in the chapter on the properties of surfaces The chapter on heterogeneous catalysis covers the field very well in a limited space. Strong electrolytes are dealt with too summarily to be quite satisfactory, and the chapter devoted to them could with advantage have been twice the present length, some rather speculative material from other sections being sacrificed The last chapter, on acid-base catalysis, gives an adequate review of the subject

Within the limits of about 500 pages, the author has managed to give a survey of a few selected parts of modern physical chemistry, which is perhaps as satisfactory as is possible No one will consider that every section is adequate and most teachers will wish that other subjects in which they are interested could have been included This would, however, have defeated the object of the author in giving a concise yet adequate survey of a few topics, and would have caused the book to grow to at least double its present size The references to the literature will enable the teacher to equip himself for lectures and the keen student to extend the knowledge of subjects in which he has been interested by the author

Dr. Glasstone's book fills a well-defined place in the literature and there is little doubt that it will remain popular for some time, especially if the author takes such pains to keep the material up to date as he has in the present revised edition The book is well printed on a rather heavy paper and is somewhat expensive for its size

J. R PARTINGTON.

Short Reviews

Anthropology

Valenge Women the Social and Economic Life of the Valenge Women of Portuguese East Africa An Ethnographic Study by E Dora Earthy (Published for the International Institute of African Languages and Cultures) Pp xi+251 + 24 plates (London Oxford University Press, 1933) 25*s* net

ALTHOUGH the entry of women into the anthropological field has begun to fill what was for long a serious gap in ethnographical investigation, much has still to be done The value of observation from the woman's special point of view is well illustrated by Miss Earthy's study of Valenga women The Valenga were described to a certain extent by M Junod in his book on the Bathonga, but Miss Earthy has carried his observations further; and writing with the place and function of women in the community more particularly as the subject of investigation, she has given a fresh orientation to subjects usually regarded too exclusively from the point of view of the male members of the tribe This is especially to be noted in the account of such a topic as marriage, and appears very clearly in her account of the details of the observances which precede, accompany and follow the rite It also has an important influence on the account of family relations

The most valuable contribution to our knowledge, however, will be found in the account of female initiation, where the author has been able to add to her generalised account of the rite, the recollections, reported in detail, of individual initiates who had undergone the ceremony at varying periods in the past It has thus been possible to note changes which have taken place in the rite, and to draw inferences as to its original character from observances which have vanished in recent years

La race, les races. mise au point d'ethnologie somatique Par Prof George Montandon (Bibliothèque scientifique) Pp 299+24 plates (Paris · Payot et Cie, 1933) 25 francs

PROF G. MONTANDON, now professor of ethnology at the École d'Anthropologie, Paris, has given us in this book an introduction to the study of the races of man which is intended for both the beginner and the layman He opens with the study of 'race', defining it, and then dealing with the various methods of study and the characters by which race is differentiated in man Particular attention is paid to the latest developments of the study of heredity as applied to human races, and the evidence which may be afforded by the blood groups is demonstrated. He then deals with racial origins and distribution, electing the hologenetic in preference to the monogenetic point of view. Next he passes on to the description of the significant physical characters in each of the principal races of mankind, classifying them under the main headings of pygmies, negroids, Ved-Australoids, Mongoloids and Europoids M. Montandon's concept of racial filiation leads to an original plotting of racial migrations, which would bring the earliest immigrants into America by way of the south instead of the more generally accepted north Here he accords with the theories of M Rivet and others M Montandon expounds difficult material with great clarity

Biology

La paléontologie et les grands problèmes de la biologie générale 1 *L'Évolution, adaptations et mutations, berceaux et migrations* Par Prof Charles Fraipont et Dr Suzanne Leclerq (Actualités scientifiques et industrielles, 47) Pp 38 9 francs 2 *Adaptations et mutations, position du problème* Par Prof C Fraipont (Actualités scientifiques et industrielles, 48) Pp 26 6 francs (Paris Hermann et Cie, 1932)

THESE two pamphlets discuss certain evolutionary problems from the palæontological point of view Part 1 considers the question of 'cradles' or points of origin of species, and their subsequent migrations Maps are given showing the geological as compared with the present distribution of various plant and animal groups The plants considered include certain Marattiales, the tropical genus *Engelhardtia* of the Juglandaceæ, *Juglans*, the Ginkgoales, Araucarians, *Taxodium*, *Sequoia* and *Eucalyptus* The animals include the Athyridæ (Brachiopods), the Rhynchocephalians, the mastodons, elephants and horses It is, of course, well known that these groups show marked contraction in the areas occupied by them during successive geological periods This the authors call "centripetal concentration", and they draw the much more debatable conclusion that each species or group began with a maximum distribution—often world-wide—which has since undergone progressive reduction

The theory of centres of origin is thus denied, the alternative being that a species is derived simultaneously over the whole of its area from a previous species—a view which many will find unacceptable

Part 2 is a short review of theories of transformism, in which the Lamarckian principle is upheld, but without any new evidence in its favour. The conclusion is expressed that adaptation is the basis of the formation not only of species but also of genera, orders and all important systematic groupings. Many modern biologists would consider this extreme view to be gainsaid by a mass of evidence, particularly from systematic botany

R. R G.

Life and Living a Story for Children By Dr E P Phillips Pp xiv+152 (Ashford L Reeve and Co, Ltd, 1933) 5*s* net

Dr Phillips has aimed at presenting the facts underlying problems of life which are usually taboo in the curriculum of the adolescent boy or girl The delicate, yet straightforward, manner in which he tells the story of sex, evolution and heredity is striking In fact, we may say that it is the best exposition of the subject of this standard we have read

The subject matter is one complete whole The story opens with reflections on life in general Then follow several chapters devoted to various forms of reproduction in the plant and animal kingdoms, leading up to man The structure, evolution, and psychology of man is then dealt with in more detail Civilisation and culture receive treatment in the last several chapters, where marriage, morals and religion are discussed

It is a pity that Dr Phillips has not given less space to sex and devoted more to certain other aspects of the biology of life Much of the material on religion and morals, too, we think, should have been curtailed in a book meant for readers of such tender years

Unfortunately, people are seldom prepared to buy such books for their children, few schools will be able to afford the price But, though the aim of the author is rather narrow, and not a general survey of biology, it is an excellent book, and, in schools, would form a splendid supplement to a more formal treatise As a home reader it is most desirable The author has a compelling style, and many of the diagrams are well executed and refreshingly original in style

Invertebrate Zoology By Prof Robert W Hegner Pp xiii+570+8 plates (New York The Macmillan Co, 1933) 20*s* net

This work has grown out of the revision of the author's "Introduction to Zoology" (1912) and is intended for students who have already taken their first course of zoology and desire to obtain a more comprehensive knowledge of the invertebrates While prepared primarily for American students, and citing wherever possible American examples, it will be found useful by students elsewhere, as it is written in an interesting manner and deals adequately with the principal features of structure and biology of representative members of the respective groups

The first 118 pages are devoted to the Protozoa and, as would be expected from the author's expert knowledge of this phylum, contain a trustworthy and clear account in which the parasitic forms receive their due, but not an undue, share of attention Praiseworthy features of the book are its attention to the biology of the groups and the inclusion at the end of each of the more important groups of a brief history of our knowledge of the group A short bibliography is appended to each chapter A few of the smaller groups are rather summarily dealt with; for example, the Brachiopoda, Chætognatha and *Phoronis* are all contained in four pages The statement that the larva of *Phoronis* resembles a trochosphere may lead to misapprehension, and the body cavity of Nematoda should not be called a cœlom The author has been, as he states, at considerable pains to bring his book up to date and he deserves commendation for his success in dealing with a great body of material so skilfully

Birds of the Falkland Islands a Record of Observation with the Camera By Arthur F Cobb Pp 88 (London H F and G Witherby, 1933) 7*s* 6*d* net

The contents of the volume are practically all, if not entirely all, the written result of the author's own seven years' residence on Bleaker Island and other islands of the group It is not, perhaps, intended to be a scientific treatise on the birds of the Falklands, nor to be an exhaustive list of the birds which occur there, on the other hand, nobody who reads the book can fail to find much in it that is both novel and interesting No descriptions are given of the various birds referred to The letter-press deals entirely with notes on the range, habits and nidification of each species Altogether it gives notes on thirty-one species of birds found on the islands, including geese and ducks, penguins, albatrosses and gulls, waders and birds of prey

The photographs which accompany the letter-press are very good and are of especial interest, for the author has taken pains to include many which show the type of country the birds inhabit, while there are many excellent plates of breeding haunts, nests and eggs

This is a little book which can be recommended with confidence to anyone with an hour to spare who would like to learn something hitherto unrecorded about the birds of the far-off Falkland Islands It is well got up, the printing good and the misprints rare

Chemistry

Qualitative Chemical Analysis certain Principles and Methods used in Identifying Inorganic Substances together with a Systematic Survey of the Chemistry of these Materials By Dr Roy K McAlpine and Dr Byron A Soule (Based upon the text by A B Prescott and O C. Johnson) Pp. xii+696 (London Chapman and Hall, Ltd, 1933.) 21*s* net

This manual is much more than a treatise on qualitative analysis, since it contains a mass of general information on the elements and compounds which are likely to be met with in the analysis of inorganic materials, including the less common elements It is provided with full references to the literature The group separations are the usual ones, but the tables for each group are arranged in an unusual symbolic form which is far from clear. On account of the large amount of detail, the work is not suitable for the elementary student, who requires a clear set of tables, but the advanced student, the teacher and the practising analyst will find it of interest and value. With so much detail, some mistakes are almost inevitable, as when dithionic acid is said to be obtained (p. 511) by the action of carbon dioxide on barium dithionate, and the product of the action of stannite on bismuth salts is given as bismuth oxide (BiO) on p. 244 and (correctly) as bismuth on p. 224. The long section on balancing equations (pp. 629–656) is of doubtful value, and that on solubility product (pp. 44–137) is, as the authors recognise at the end, too far removed from practice to serve as a safe guide in the laboratory. The book is one which every chemical laboratory could usefully have available for reference.

A Short Organic Chemistry. By Dr. F. Sherwood Taylor. Pp. viii + 378. (London: William Heinemann, Ltd., 1933.) 5*s*.

THE present book is an abridged form of the larger work by the same author and contains those parts of the subject required by the first year student. The theoretical parts are almost as full as in the longer book and the treatment of the simplest and most important compounds remains almost unaltered. Experiments are described, so that the book gives a complete course in elementary organic chemistry. There are also questions and numerical and other problems, with answers. The text is clear and accurate and the brief descriptions of large-scale operations are much more up-to-date than is usual in such books. The modern formulæ of the carbohydrates are given. The discussions of theoretical matters, such as stereoisomerism and the structure of benzene deserve special commendation. Dr. Taylor's book is a very satisfactory course of elementary organic chemistry and can be recommended both for schools and for junior students in universities.

Laboratory Tables for Qualitative Analysis. Drawn up by the Demonstrators in Chemistry, University of Manchester. Fourth edition, revised and rewritten by Dr. Colin Campbell and J. B. M. Herbert. 17 cards. (Manchester: Manchester University Press, 1933.) 3*s*. 6*d*. net.

THESE tables have been familiar to several generations of students passing through the Chemistry Department at Manchester and their excellence has been amply demonstrated over a long period of time. In their new form an alternative scheme for the separation of phosphoric acid in Groups III–IV is given, and two sheets on the less common metals, Be, Mo, Ti, V and W, provided. The explanatory notes, a very valuable feature of the tables, remain, but have been revised when necessary in the light of modern theory. These tables provide a scheme of qualitative analysis which has been thoroughly tested and their use can be recommended in all chemical laboratories.

Chemical Calculations: their Theory and Practice. By A. King and Dr. J. S. Anderson. Pp. x + 181. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., Inc., 1933.) 4*s*. 6*d*. net.

THE present collection of examples is accompanied by explanatory matter which is found in all the usual textbooks and could quite well have been omitted. Whilst brief summaries of the theory are desirable in the case of books of calculations on physical chemistry, they take up space and add to expense in elementary works. The examples given are very suitable for students taking the Intermediate Science and Higher School Certificate examinations. Answers are provided to alternate problems only. The calculations in volumetric analysis are all based on the use of normalities, and an insistence on this will remove the habit acquired by some students of working out such results by unnecessarily long and unscientific methods. The book is a good and straightforward collection of problems which should fulfil the purpose for which it was written.

Mathematics

(1) *Logarithmetica Britannica: being a Standard Table of Logarithms to Twenty Decimal Places.* Part 6: *Numbers 60,000 to 70,000.* By Dr. Alexander John Thompson. Issued by the Biometric Laboratory, University of London, to commemorate the Tercentenary of Henry Briggs' publication of the *Arithmetica Logarithmica, 1624.* (Tracts for Computers, No. 18.) Pp. v + 100. (Cambridge: At the University Press, 1933.) 15*s*. net.

(2) *Tables for the Development of the Disturbing Function: with Schedules for Harmonic Analysis.* By Ernest W. Brown and Dirk Brouwer. Pp. v + 73–157. (Cambridge: At the University Press, 1933.) 10*s*. 6*d*. net.

(3) *Vierstellige Tafeln der Kreis- und Hyperbelfunktionen, sowie ihrer Umkehrfunktionen im Komplexen.* Berechnet und erlautert von Robert Hawelka. Im Auftrag des Elektrotechnischen Vereins E.V. in Berlin, herausgegeben von Prof. Dr. Fritz Emde. Pp. v + 109. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1931.) 10 gold marks.

(1) THIS, the fifth part published, contains a frontispiece photographic reproduction of a letter from Henry Briggs to John Pell. Dr. Thompson hopes to produce another part containing the logarithms of numbers from 10,000 to 20,000 some time this year.

(2) These tables give coefficients designed to facilitate the numerical development of the disturbing function in planetary perturbations. Writing

$$(1-\alpha^2)^s(1+\alpha^2-2\alpha\cos S)^{-s}=\tfrac{1}{2}G_s^{(0)}+\sum_{i=1}^{\infty}G_s^{(i)}\alpha^i\cos iS,$$

Tables I–IV give eight place logarithms of the G's for $s=\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2}$, $i=0,1,2, \ldots, 11$, with the argument $p=\alpha^2 - (1-\alpha^2)$ in the interval 0·00 – 2·50. Table V gives coefficients of the expansion of $G_i^{(i)}$ in powers of $(p-3)$ and $(p-4)$ Tables VI and VII give $(1-\alpha^2)^{\frac{1}{2}} G^{(i)}_s$ for $i=0-4$, $s=\frac{1}{2}, \frac{3}{2}$, with the argument α in the interval 0.900–0.950 The remaining tables give certain special data. Schedules for harmonic analysis are appended with fully worked examples

(3) These useful tables give, to four decimal places, circular and hyperbolic sines, cosines, tangents and cotangents of the complex argument $\frac{1}{2}\pi x+iy$, and the corresponding inverse functions The unit of the real part of the angle being a right angle, the whole complex plane is covered by taking x from 0 to 1, y from 0 to 1 and then y^{-1} from 1 to 0, all at interval 0.02 A similar device is adopted for the inverse functions Printed first differences are given both down and across the tables Where linear interpolation is insufficient, exponential interpolation is used by means of an auxiliary table The auxiliary tables, nomograms, and reliefs of the functions are in a separate removable part, which makes their use very convenient L M M -T

Theory of Functions: as Applied to Engineering Problems Edited by R Rothe, F Ollendorff and K Pohlhausen Authorized translation by Alfred Herzenberg Pp x+180 (Cambridge, Mass: Technology Press, Mass Institute of Technology, 1933) 3.50 dollars

The well-known German book, "Funktionentheorie und ihre Anwendung in der Technik", published in 1931, is now available in an English translation The first section, written by R Rothe of Berlin, is devoted to a mathematical discussion of the functions required in the solution of many advanced engineering problems It deals with the complex variable, line integrals and their relationship to potential theory, complex integration, power series and Laurent's series, residue theorems and singularities

The second section is concerned with the applications, and each problem is dealt with by an expert Electric and magnetic fields are discussed by W Schottky, two-dimensional fields of flow by K Pohlhausen, field distribution in the neighbourhood of edges by E Weber, the complex treatment of electric and thermal transient phenomena by F Ollendorff, and the spreading of electric waves along the earth by F Noether

The text is well written though essentially brief, and it is claimed that the book is the first authoritative work on its subject in English It should certainly be of great value to all who are interested in the study of those new practical problems to which the advance of science continually gives rise.

Cours de mécanique rationnelle Par Jean Chazy (Cours de la Faculté des Sciences de Paris) Tome 1 *Dynamique du point matériel.* Pp v+392 (Paris Gauthier-Villars et Cie, 1933.) 70 francs.

The book before us is the first volume of a course in mechanics given by the author at the Faculty of Science at Paris. In accord with its sub-title, it deals with vectors, the fundamental principles of dynamics, general theorems, the motion of a particle—rectilinear, curvilinear and upon a surface—and finally, with motion relative to the earth.

In characteristic French style, there are no exercises for the reader, whilst the text is mainly devoted to a discussion of general theorems, very few particular cases being deduced The simple pendulum, for example, is first worked out as an elliptic integral, whilst the simple case of replacing $\sin\theta$ by θ is disposed of in a short note at the end The whole course is nevertheless very useful and interesting, but the price is somewhat high for the average British student

Miscellany

(1) *Goethe als Chemiker und Techniker* Von Paul Walden Pp. 87 (Berlin: Verlag Chemie G m b H, 1932) 2 gold marks

(2) *Gothes naturwissenschaftliches Denken und Wirken drei Aufsatze herausgegeben von der Schriftleitung der Zeitschrift "Die Naturwissenschaften"* Pp iii+99 (Berlin Julius Springer, 1932) 3.60 gold marks.

Goethe's interest in natural science is an outstanding characteristic of his all-embracing genius His writings often display a detailed knowledge of the processes of Nature, and his intuitions in many instances are almost prophetic. When he was twenty years of age, he made experiments with the "Liquor Silicium" (1769) which led him to the view that a great deal can be discovered about the nature of the elements by paying attention to the geometrical arrangement of their particles In 1795 he wrote to Humboldt, "you enquire into the mysteries of nature through its elements, whereas I do by watching their configuration" Indeed, this is the fundamental principle of the colloidal theory which developed later with such remarkable results Already in 1786, Goethe had noticed that the crystals of common salt take various forms—an indication, he wrote, that they are not pure So great was his faith in natural configuration that he proclaimed, in the same year, that mineralogy without chemistry cannot progress one inch. His interest in the science of matter remained with him throughout his life In 1819, he was much puzzled by the constitution of coffee, and when he made the acquaintance of young Runge, who was later to discover aniline, Goethe gave him some coffee beans suggesting that their analysis might interest him One year later, in 1820, Runge communicated to Goethe his discovery of cafein

A score of interesting details about Goethe's scientific views and the state of science during his lifetime, will be found in the two pamphlets under review Thus we are told how Goethe came to study chemistry and its technique, and what are his most original views on the subject. A supplement of thirty pages in the second pamphlet gives a short analysis of his main achievements in the various branches of physical science. T. G.

(1) ***Basic German for Science Students With Vocabulary and English translations of the German Passages*** By Dr M L Barker Pp xi+164 (Cambridge W. Heffer and Sons, Ltd , London Simpkin Marshall, Ltd , 1933) 6s net

(2) ***The Basis and Essentials of German containing all that must be known of Grammar and Vocabulary in order to express the most frequently recurring Ideas*** By Charles Duff and Richard Freund. Pp xix+113 (London Desmond Harmsworth, Ltd , 1933) 3s 6d net

(3) ***A German Reader for Biology Students Passages from Recent German Scientific Publications*** Selected and arranged by Prof H G Fiedler and Dr G R de Beer With a Vocabulary by Herma E Fiedler Pp vi+92 (London Oxford University Press, 1933) 5s

(1) In twenty-four pages, Dr Barker crowds in the essentials of German grammar in tabloid form and as footnotes to selected passages from the Bible The rest of the book gives general passages from scientific works in German with English translations, and more technical selections referring to chemistry, zoology, botany, physics, mathematics and medicine Unfortunately, only one English rendering is generally given to a German word, although it often has other equally important significations

(2) Equally useful for the general reader is the book by Messrs Duff and Freund Though they give the minimum of grammar, however, they stress the importance of the vocabulary, which is selected and presented in such a way as to cause the least difficulty to an English reader The authors have compiled a large number of German books, noting down the words which occur more often and drawing statistical lists of them They selected for their book those with the highest coefficient, and divided them between those which are similar to their English equivalent, and those which are different Some sound guiding principles here and there help the reader to understand the use and memorise whole lists of words

(3) The work compiled by Prof. Fiedler and Dr. de Beer is simply a selected series of passages from recent German scientific literature, supplemented by an appropriate vocabulary. This reader is intended to be used by students of biology as a supplement to a "First German Course" by Prof Fiedler and F. F Sandbach

The Laboratory Workshop a Simple Course in Apparatus Making and the Use of Tools. By E H Duckworth and R Harries Pp xi+246 (London · G. Bell and Sons, Ltd., 1933) 10s net

This book contains information necessary to the man who has what Dewar called "the use of his hands", but who has not had workshop training, and is thus penalised in much loss of time and endeavour when setting himself to make and mend models, instruments and apparatus. Here also can one learn what materials are most serviceable, and how they are described, and where obtained ; what are the most useful tools , and many suggestions, by the way, about the value of second-hand oddments and out-of-the-way uses for common things ; also valuable sections on glass-working and electrical wiring, with much more of the lore of an experienced laboratory assistant All this is made plain by a large number of clear drawings, over which much labour must have been spent On the other hand, of the two photographs comparing an attic workshop with one for a laboratory, uncertainty may be felt whether to admire the attic or be uneasy about the laboratory , partly no doubt because the detail available is insufficiently informing Many examples have been included of actual constructions of demonstration apparatus and models

One lack that will almost certainly be felt, however, is the determined omission of even simple lathe work it is not easy to understand how anybody in a position fully to utilise the help of this book will be satisfied without the service of at least a simple form of lathe No doubt a later edition will include this extension, since a knowledge of the proper use of the ordinary cutters is not easy to obtain W J G

A Retired Habitation a History of the Retreat, York (Mental Hospital) By H C Hunt With a Foreword by Dr B Pierce and a Chapter by Dr N Macleod Pp xvi+144+12 plates (London H K Lewis and Co , Ltd , 1932) 7s 6d net

The man in the street and the educated layman are extraordinarily uninformed on the subject of the care and treatment of the mentally afflicted, so that it is very interesting to read the history of "The Retreat, York", a title which is very familiar to many The title "A Retired Habitation" is, we think, a great mistake, for it does not convey any indication of the contents of the book, especially when those contents consist of the history of a very great and humane undertaking.

Mr Capper Hunt, the steward at "The Retreat", has given us a very simple and readable account of the development of this registered hospital for the treatment of mental disorder, but we could have wished that he had made it much fuller and given greater detail

Nevertheless, it is a fascinating story and very well presented The extraordinary kindness and consideration shown to the mental patients in the far off days of the early nineteenth century by the nursing staff appointed by the Friends are an object lesson to many of the twentieth century The same spirit has always prevailed, and to-day the standard of nursing at "The Retreat" is second to none, and to the late Dr. Bedford Pierce the modern mental nurse may well be very grateful for all he did to secure the "one portal" entry by examination to the State Nursing Service The book is very well presented and the illustrations excellent.

Nowe Drogi Nauki: Kwanty i Materja. Napisał Dr Leopold Infeld. (Z Dziedziny Nauki i Techniki, Tom 2.) Pp. x+284+6 plates. (Warszawa: *Mathesis Polskiej,* 1933.)

DR. INFELD's "New Developments in Science" presents to Polish readers an account of the most recent advances in physics and chemistry, particularly in the domain of sub-atomic phenomena and the structure of matter. The author opens with a reference to Pascal's views (1647) on the aims of physical inquiry and, after a brief historical sketch, proceeds to describe current ideas concerning matter and energy, X-rays, the quantum theory and the new wave mechanics. Attention is directed to the important discoveries of the last few years, including the Compton and Raman effects.

The book, which is well-printed and well-bound in cloth, is illustrated with some good photographs and should serve to acquaint Polish students with the latest developments and discoveries in the borderland of physics and chemistry.

Physics

Introduction to Theoretical Physics. By Prof. John C. Slater and Prof. Nathaniel H. Frank. (International Series in Physics.) Pp. xx+576. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1933.) 30s. net.

THIS is, in some ways, a remarkable book. The authors are convinced that the teaching of physics by way of a series of separated and more or less watertight courses prevents a student from understanding the unity of physics. Moreover, many problems concerning the structure of matter are necessarily discussed in terms of wave mechanics, and a knowledge of wave mechanics again demands a thorough grounding in classical physics. The authors, therefore, with amazing courage, have endeavoured to build up, in the compass of less than six hundred pages, a consistent and comprehensive picture of modern theoretical physics which shall be something more than a collection of disjointed chapters on unrelated topics.

This task requires some forty-two chapters and the authors are not afraid to begin with such elementary notions as are needed for a brief (and possibly to the pure mathematician inadequate) discussion of power series and Taylor's theorem, exponential methods for the solution of differential equations illustrated by simple physical applications, damped and forced oscillations, vector forces and potentials. Fifty-eight pages of this work bring us to Lagrange's and Hamilton's equations, phase space, precessional motion, vibrating strings and membranes, elasticity, fluid and heat flow. Thence we are led to potential theory, Maxwell's equations, electromagnetic waves, and electron theory. Huygen's principle and Fresnel and Fraunhofer diffraction phenomena are disposed of in twenty-six pages, and the way is now clear for discussions of wave mechanics, Schrodinger's equation, the correspondence principle, matrices and perturbation theory. Then within the limits of about a hundred and fifty pages the authors find space to discuss compactly but very clearly some of the details of atomic and molecular structure, equations of state, nuclear vibrations, collisions, electronic interactions and electronic energy of atoms and molecules, Fermi statistics, and dispersion, dielectrics and magnetism. The book is a remarkable example of unhurried and unostentatious compression, and the authors are to be congratulated on the result of their endeavour "not to teach a great collection of facts, but to teach mastery of the tools by which the facts have been discovered and by which future discoveries will be made".

The book is admirably produced. Each chapter is followed by a set of problems, and judiciously selected references will aid the student in his future reading. A. F.

The Electromagnetic Field. By H. F. Biggs. Pp. viii+158. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 10s. 6d. net.

AT its lowest, the mathematical instrument of vector algebra is a labour-saving device, and in dealing with electromagnetic theory time spent in learning how to use the instrument is amply repaid. In many general textbooks on electricity and magnetism the introduction of a mathematical technique which may be unfamiliar to probable readers is avoided; and students of physics often find considerable difficulty in bridging the gap between the Cartesian treatment and the vector treatment usually adopted in more advanced treatises. It is to such students that this book of Biggs is addressed.

The use of vector notation in the representation of static fields is first described, and the circuital relations are developed. Div, curl and related vectorial operators are discussed in connexion with Maxwell's equations, and the relations involving the general scalar and vector potentials are then considered. Many applications are given, and there are neat proofs of a number of well-known theorems. In little more than a hundred pages the author develops practically all of the more important mathematical relations of classical electromagnetic theory. A useful table shows the connexion between the relations discussed, and indicates clearly those which are derived directly from experiment.

The last chapter, which is concerned with the Lorentz transformation, gives an admirable introduction to tensor methods, and to the relativistic four-dimensional formulation of the theory.

The book as a whole should be most useful to all those physicists who can appreciate mathematical methods most readily when they are presented in close connexion with physical applications. E. C. S.

Physics for Medical Students. a Supplementary Text Book By J S Rogers Edited by Prof T H Laby Pp x+205 (Melbourne Melbourne University Press, London Oxford University Press, 1933) 11*s* 6*d* net

IT is very desirable that the attention of teachers of physics and medical students, including qualified medical men, should be directed to this book, for it represents the first attempt, so far as the reviewer is aware, to supplement the ordinary textbooks of physics which are given to medical students It is a very successful attempt to show that physics is a science which really does have an intimate connexion with the theory and practise of the art of healing, as well as with the necessities of everyday life Such a book has long been wanted and the author well deserves our congratulations on his achievement

The opening chapters give a brief but very good outline of the history of physics Incidentally, the author follows tradition in ascribing to Davy an experiment with blocks of ice which he never performed, for Davy did not rub pieces of ice together *in vacuo*, he rubbed them together in air, and he recorded an impossible result Later chapters give excellent accounts of osmosis, the colloidal state of matter, ultra-violet light, the microscope, hydrogen ion concentration, high frequency currents and X-rays In all these chapters the importance of physical facts and theories to medicine is stressed, whilst the chapters on blood pressure and its measurement, body temperature, gains and losses of energy in the human body, the resonance theory of hearing, the human eye and the therapeutic uses of radiations also testify to the industry and diligence which the author has so successfully employed in showing that physics can be made interesting to medical students

The book is well printed and illustrated It is very pleasant to read and the manner in which the author has everywhere tabulated and arranged the most striking and important points in each section makes it a handy book of reference There are obvious ways in which the author may expand this work in future editions, and it is to be hoped that it will find an extensive sale in Great Britain

L F. B

Bulletin of the National Research Council No 90 *Physics of the Earth.* 6 *Seismology* Pp viii+223 (Washington, D C National Academy of Sciences, 1933) Paper, 2 dollars, cloth, 2 50 dollars

THIS new "Bulletin" is comprehensive and inexpensive The authors are J B Macelwane, H O Wood, H F Reid, J A Anderson and P. Byerly, all of whom have made distinguished contributions to seismology. They discuss the various theories of the origin of earthquakes, field data, the design of seismographs, the theory of wave propagation, and the interpretation of the results References are abundant up to 1931, and there are a few for 1932, and the authors have evidently read and understood what they quote Two omissions are perhaps worthy of notice The work of Stoneley and Tillotson on surface waves is mentioned without statement of the results they derive for the thicknesses of the layers, and attention might have been paid to the theoretical solution for a sudden disturbance spreading in three dimensions from a small region

The book is not made needlessly long by the inclusion of out-of-date material, but the reviewer is left in doubt as to whether Uller's theory of wave propagation needed exposition Is this very complicated work really able to give any results that cannot be obtained quite easily otherwise? So far as the reviewer can see, it has all the defects of the method of normal modes and none of its virtues But on the whole the book is the most convenient guide to seismology that has yet appeared

H J

Physical Constants Selected for Students By Dr W H J Childs (Methuen's Monographs on Physical Subjects) Pp viii+77 (London Methuen and Co, Ltd, 1934) 2*s* 6*d* net

THIS little volume of physical constants is well designed in many ways to suit the student's pocket It is most convenient in form and size, and its price is so modest that few students will be unable to purchase the book It is sufficiently complete to satisfy practically all the requirements of the ordinary teaching laboratory and most of the normal requirements of a research laboratory

Psychology

Mental Defect By Dr Lionel S Penrose (Text-Books of Social Biology) Pp xi+183+4 plates (London Sidgwick and Jackson, Ltd, 1933) 8*s* 6*d* net

MENTAL defect or more technically, oligophrenia, is such a serious problem that no apology need be made for stressing the extreme importance of educating public opinion So much inaccurate and prejudiced opinion finds its way into print, particularly in the more sensational daily Press, that an effort should be made to combat it Dr Penrose's book is meant for medical or educated lay readers and is therefore not suitable for "the man in the street" He gives an interesting and accurate account of the physical conditions met with in defectives of all classes, and discusses the psychological examination, the taking of family and personal histories, and the classification In discussing mongolism, the writer expresses the opinion that Crookshank's view that the condition is a regression to earlier ancestral types cannot be upheld He does not express an opinion on Clark's view that the condition represents a condition of fœtal hyperthyroidism

It is very gratifying to read a sane account of sterilisation The author points out that only one defective out of twenty is born of defective parents, that many defectives are unlikely to produce children and that it is mostly the high grade ones who are difficult in this way. This of course is exactly the group that are difficult to deal with from a legal point of view In the author's opinion, adequate segregation is a much more rational procedure , sterilisation is no solution of the problem of the mental defective

Psychoanalysis and Medicine a Study of the Wish to Fall Ill By Karin Stephen Pp vi+238 (Cambridge At the University Press, 1933) 8*s* 6*d* net

DR KARIN STEPHEN bases her book upon a series of eight lectures which she delivered mostly to medical students at Cambridge She has an exceptionally good grasp of her subject, and adopts as the basic idea of her book the hypothesis that neurotic symptoms are defences designed to prevent anxiety from developing when repression threatens to give way Dr Stephen is an out-and-out Freudian, but there are many who will find fault with her statement ". if we can argue by analogy from the neuroses to the other group of psychogenic illnesses, the psychoses (insanity) " It is surely doubtful if any psychosis can be looked on as purely psychogenic in origin. The causation of the psychoses is a very complicated and debatable subject, and although psychoanalysis can offer explanations of mechanisms its theories of causation are not so easily applied or accepted by those best qualified to assess their value in an impartial manner

The Human Personality By Dr Louis Berg Pp xv+321 (London . Williams and Norgate, Ltd , 1933) 8*s* 6*d* net.

DR. L BERG looks on the human personality from the *Gestalt* point of view, a conception which has been gradually developing during recent years amongst those best qualified to judge. There is a number of unusually sensible statements in this book—perhaps the most sensible is "We speak of 'problem children' but we should really say problem *parents* " So many problem children are the results of errors of training in the pre-school years It is only expressing the view of one school of thought to say that manic-depressive insanity, dementia præcox and paranoia are functional diseases These disorders are not necessarily due to psychic wounds Kretschmer's rigid views as to the development of cyclothymia in pyknics and dementia præcox in asthenic types have recently had considerable doubt cast upon them and we should adopt an attitude towards them of 'not proven' To say that "schizoids become insane because of psychic wounds such as sorrow, unhappy love affairs or career failures" is using symptoms to explain causation

The Way of all Women a Psychological Interpretation. By Dr M. Esther Harding Pp xv+335 (London, New York and Toronto Longmans, Green and Co , Ltd , 1933.) 15*s* net

IT is an arguable question whether the roots of disorders of conduct and life difficulties are not deeper than can be reached by reading a book, however good it may be. Dr Harding has attempted to explain many difficulties of life, but whether her explanation would be accepted or not by the neurotic and those in difficulties is another matter The unconscious has an unfortunate habit of erecting barriers against the very explanations given, and a prolonged analysis is often necessary to get behind these barriers and adjust the mind in difficulties to its difficulties Apart from this, however, the book contains a wealth of sound advice, and there can be few who, having read it, will not derive benefit if they apply the theory to their practice.

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Letters to the Editor

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Inner Conversion in X-Ray Spectra

MORE than ten years ago, Coster[1] reported that he had carried out experiments with heavy elements for tracing X-ray characteristic lines due to the transition $L_1(2s) \leftarrow L_{2,3}$ $(2P_{1/2}, {}^2P_{3/2})$, but got no positive results During the last ten years, a number of other investigators[2] have also reported negative results

These failures have remained rather mysterious for the transition $L_1 \leftarrow L_{2,3}$ ($\Delta n = 0$) is not forbidden by quantum mechanics and actual calculation based on wave mechanics shows that the expected line should be quite intense A recent search by one of us (J B M) for the expected line of W ($L_1 - L_3$, $\nu/R = 139\ 5$, $\lambda = 6\ 4$ A) also yielded no positive result though both the excitation and exposure were more than sufficient A search into the current literature shows that though these lines ($L_1 \leftarrow L_3$) have not been obtained, a number of lines of heavy elements (73 Ta to 81 Tl) due to the transitions between N levels ($N_{4,5} \leftarrow N_{6,7}$) have been obtained by Thibaud[3], del Rosario[4], Magnusson[5], Prins and Takens[6], while the last two workers report lines due to the transitions ($M_{2,3} \leftarrow M_{4,5}$) of a number of elements Since in all these lines, $\Delta n = 0$, the failure to obtain the lines due to the transition ($L_1 \leftarrow L_3$) was remarkable

It appears to us that the failure to obtain the ($L_1 \leftarrow L_3$) line is to be completely ascribed to the inner conversion of such lines in the M levels of the elements A scrutiny of the L level values of the elements shows that from 92 U to 68 Er the ($L_1 - L_3$) values are greater and very close to the M level values; for example, in W, the ν/R value for ($L_1 - L_3$) is equal to 139 5 while $M_4 = 137\ 5$, $M_5 = 132\ 9$

An application of a modified form of the formula for inner conversion given by Miss Swirles, Taylor and Mott, and Hulme[7] shows that the ($L_1 - L_3$) lines should be completely converted in such cases It is only in 68 Er that the ($L_1 - L_3$) ν/R value is just less than any of the M-level values and much larger than N-level values But this situation persists only up to 55 Cs, from iodine again, $L_1 - L_3$ becomes just larger than some M-values, so that it is expected that only elements from Er to Cs are capable of showing lines due to ($L_1 \leftarrow L_3$) transitions This conclusion has not yet been tested

It appears that the phenomenon of inner conversion is responsible for many of the intensity anomalies which are observed in the line spectra of X-rays, as was suggested some years ago by Wentzel.

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University of Allahabad

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[1] Coster, *Phil Mag*, 44, 945, 1922
[2] Idei, NATURE, 123, 643, 1929.
[3] Thibaud, *Phys Z*, 29, 241, 1928
[4] del Rosario, *Phys Rev*, 41, 136, 1932
[5] Magnusson, *Z Phys*, 79, 161, 1932
[6] Prins and Takens, *Z Phys*, 75, 743, 1932 *Z Phys*, 77, 795; 1932
[7] Swirles, *Proc Roy Soc*, 116, 491, 1927 Hulme, *Proc Roy Soc*, 138, 1932 Taylor and Mott, *Proc Roy Soc*, 138, 1932, and 142, 1933.

Disintegration of the Separated Isotopes of Lithium by Protons and by Heavy Hydrogen

THE two known isotopes, Li^6 and Li^7, have been separated in quantities of the order of one microgram by two separate methods depending on the passage of several microamperes of lithium ions through electric and magnetic fields The separate isotopes were collected on metal discs cooled with liquid nitrogen, and after fixation by exposure to hydrochloric acid gas, were bombarded by protons and by diplons in an apparatus already described[1] It was possible to observe several hundred disintegration particles each minute from the Li^7 targets and about half that number from the Li^6 targets arranged to contain about the same number of atoms The results are summarised in the accompanying table

Bombarding Particles	Lithium 6	Lithium 7
Protons	α particles of 11 5 mm range	α particles of 8 4 cm range
Diplons	α-particles of 13 2 cm range	α-particles up to 8 cm range
	Protons of 30 cm range	Neutrons

The purity of the separate samples was apparent from the very small number (less than 1 per cent) of the 8 4 cm particles obtained from the Li^6 target, and the total absence of 13 2 cm particles from the Li^7 target

It may be seen from the table that observations have been made not only on the α particles but also on the protons and neutrons liberated from lithium by heavy hydrogen Owing to the absence of the much more abundant Li^7, the Li^6 targets show very clearly the presence of the very definite range of doubly charged particles previously reported[1] at 11 5 mm The mica window through which the particles escaped into the detecting chamber had an absorption equivalent to 6 mm of air, so that the origin of the shorter 7 5 mm range group also found previously could not be determined

These observations are in complete accord with the assumptions made in previous papers[1] Details of the isotope separation will be published elsewhere

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E S SHIRE
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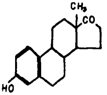
[1] *Roy Soc Proc*, A, 141, 722, 1933, and references given there

Dehydrogenation of Œstrin

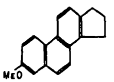
THE chemical constitutions of ketohydroxyœstrin and trihydroxyœstrin are now largely established, mainly by the investigations of Butenandt, Marrian, and their collaborators There remain, however, certain features of the molecular structure which have not yet been experimentally proved, but depend upon the assumption that the hormones are biological degradation products of cholesterol The experiment now recorded was undertaken as a preliminary step in an attempt to obtain confirmation of some of the structural details which are still in doubt

Although Butenandt[1] has shown that trihydroxyœstrin may be transformed into 1 . 2-dimethylphenanthrene by selenium dehydrogenation of the dicarboxylic acid arising by fission of the five-membered ring IV, the dehydrogenation of the hormone itself, with the tetracyclic system still intact, has given very unsatisfactory results. The only pure substance which has been obtained hitherto is chrysene (0 0049 gm from 5 4 gm of crude crystalline hormone), which was isolated by Butenandt and Thompson[2] from the products of zinc dust distillation of ketohydroxyœstrin Nevertheless, it is clear from recent work on the selenium dehydrogenation of polycyclic compounds of known structure containing five membered rings (for example, Cook and Hewett[3]) that suitable œstrin derivatives ought to be capable of smooth conversion into derivatives of a *cyclo*-pentenophenanthrene by this method

This is, in fact, the case In order to avoid complications due to substituents in the five-membered ring, the carbonyl group of ketohydroxyœstrin was first reduced to a methylene group (Kishner-Wolff method) Dehydrogenation of the 'desoxo' compound so formed led to a non-acidic substance by some secondary change involving the hydroxyl group In the remainder of the material (0 75 gm) the hydroxyl group was therefore methylated before dehydrogenation The resulting methoxy compound (m p 76°–77°; Butenandt[4] gives 72°) was heated with selenium at 300°–320° for 24 hours, the product was distilled over sodium in a high vacuum, and the distillate was finally recrystallised from alcohol There was obtained 0 125 gm of colourless needles or plates (depending on the conditions of crystallisation), which gave analytical figures in good agreement with those required for a methoxy-*cyclo*pentenophenanthrene (Found C, 86 9, 86 95 ; H, 6 2, 6 4 , OMe, 12 1 per cent Mol wt , 264, 268. $C_{18}H_{16}O$ requires C, 87 05 , H, 6 5 , OMe, 12 5 per cent Mol wt , 248) This substance gave an orange-red picrate, m p 135°–136 5° (Found C, 60 8 ; H, 4 0 $C_{24}H_{19}O_8N_3$ requires C, 60 4 , H, 4 0 per cent), and a golden-orange trinitrobenzene complex, m p 160°-161° (Found · C, 62 5, H, 4 2 $C_{24}H_{19}O_7N_3$ requires C, 62 4 , H, 4 15 per cent) The melting point (134 5°-136°) of the methoxy compound was unaltered by purification through the trinitrobenzene complex



(I)



(II)

If the phenolic hydroxyl group and the five-membered ring are correctly placed in the current formula for ketohydroxyœstrin (I), then this product of dehydrogenation must be 7-methoxy-1 2-*cyclo*-pentenophenanthrene (II) The synthesis of (II) is in progress (in collaboration with Dr A Cohen and Mr C L Hewett) by a modification of the method used for the synthesis of the parent hydrocarbon, 1 2-*cyclo*pentenophenanthrene[3]

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[1] Butenandt, Weidlich and Thompson, *Ber Chem Ges* , 66, 601, 1933
[2] Butenandt and Thompson, *Ber Chem Ges* , 67, 140 , 1934
[3] Cook and Hewett, *J Chem Soc* , 1098 , 1933 , and in the press
[4] Butenandt, Störmer and Westphal, *Z physiol Chem* , 208, 170, 1932

Influence of Sensitisers on Chemical Reactions produced by Gamma Radiation

ATTENTION was first directed to the above subject during the course of an investigation on the decomposition of chloroform by radiation from radon. Chloroform is decomposed with liberation of chlorine which slowly disappears with formation of hydrochloric acid as a secondary product. The decomposition was measured by estimating the chlorine set free Certain discrepancies were obtained in the results which were largely explained when it was found that the apparent rate of decomposition was greatly influenced by the presence of the products formed This was shown by irradiating for a second time the chloroform containing small quantities of products from the first irradiation It has been demonstrated by others that traces of moisture considerably increase the decomposition of chloroform by X-radiation

Gamma radiation oxidises solutions of ferrous salts. Berthelot's solution of ferric chloride and oxalic acid, which is rapidly reduced by ultra-violet light, was found not to be reduced at all by gamma rays On the contrary, the iron in the reduced solution is oxidised to the ferric state, and the addition of small quantities of various organic and inorganic substances was found to accelerate or retard the rate of oxidation Striking results have been obtained recently with the photographic salt, potassium metabisulphite Solutions of this substance oxidise slowly in air, but more rapidly when irradiated The solutions used were of such strength that 5 c c required approximately 18 c c. *N*/1000 iodine solution for titration The radon seed (150–250 millicuries in strength) was enclosed in a lead case with walls 1 mm thick, and was held centrally in a glass tube, surrounded by 15 c c. of solution contained in a larger glass tube Two tubes of solution without radon served as controls Overnight the controls showed an amount of oxidation in 5 c c equivalent to approximately 1 c c *N*/1000 iodine The excess oxidation with radiation varied from about 2·5 to 6 c c *N*/1000 iodine

Addition of small quantities of iodine solution to the bisulphite had a negligible effect on the oxidation of the non irradiated controls, but a very great effect on the solutions irradiated, so much so that 0 04 c c. of *N*/1000 iodine added to 100 c c. of the bisulphite solution was sufficient under the prescribed conditions to bring about the complete oxidation of the irradiated solution. Potassium iodide and potassium bisulphate, added in equivalent amounts, produced the same effect Light and X rays also bring about the oxidation of bisulphite, but in the case of these radiations the sensitising action of irradiation is less marked than with gamma radiation. Glutathione, an organic compound of great importance in tissue metabolism, was prepared by Hopkins' method and tested. Although its rate of oxidation in solution was quite definitely accelerated by gamma radiation especially in the unneutralised state, the rate was not further increased by iodine, potassium iodide or potassium iodate

Crabtree and Cramer, in recent communications dealing with the action of radium on cancer cells[1], have shown that the susceptibility of cells to radium is not a fixed property of a given type of cancer cell, but changes with the environment. The effect of certain well-known inhibitors of metabolism was shown to produce varying sensibility to radium in tumour cells Prussic acid and low temperature greatly increased the susceptibility of tumour tissue to radium, anaerobiosis produced the opposite effect. The glycolytic inhibitors iodoacetic acid and sodium fluoride had little or no effect on the action of radium As a result of their experiments they suggest that it may be possible to increase the radiosensitivity of cells by introducing suitable chemical substances The results obtained in our laboratory appear to lend force to this suggestion by showing that reactions fostered by gamma-, and X-, radiations can be sensitised by small additions of chemical bodies in an analogous manner to the action of sensitisers in many well known photochemical reactions.

GEORGE HARKER

Cancer Research Committee,
University of Sydney
Dec 7

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[1] *Proc Roy Soc*, B, 113, 226, 238

Ethane from Acetic Acid

I SUGGEST that Messrs Glasstone and Hickling (NATURE, Feb 3, p 177) may spare themselves from any "comprehensive investigation of the Kolbe synthesis" This was made clear nigh on fifty years ago

Chemists were rational in the distant past Having proved experimentally, by their joint labours, in 1847–48, the truth of the conception first propounded by Berzelius, that acetic acid was "a compound of oxalic acid with the conjunct methyl", our view to-day, Frankland and Kolbe both started out as Japheths in search of Radicles Frankland went gaily off with the alcoholic iodides and metals, to bag zinc methyl and various paraffins Kolbe resorted to electrolysis but also bagged paraffins His results are recorded in the *Quarterly Journal of the Chemical Society*, vol. 2, the account was given to the Society on March 29, 1849, before anything had been heard of Kekulé.

From previous experience, regarding 'electrolysed oxygen (as) one of the most valuable oxidising agents at the chemist's disposal", thinking that "electricity might effect a separation of its conjugated constituents" Kolbe electrolysed acetic acid (as potassic salt) He obtained the result he expected, expressed in the equation

$$HO\,(C_2H_3)C_2O_3 + O = C_2H_3 + 2CO_2 + HO.$$

Kolbe's use of CO_2 (C = 6, O = 8) is of historical significance. Acids were then thought of as compounds of an acidic with a basic oxide; bearing this in mind, the equation we write to-day is the precise equivalent of Kolbe's

$$2CH_3\,CO_2H + O = (CH_3)_2 + 2CO_2 + OH_2.$$

Came 1865 Schutzenberger, following up Sir Benjamin Brodie's discovery of acetic peroxide, simply mixed an excess of barium peroxide with acetic oxide in a small flask; on warming the mixture, ethane, together with twice its volume of carbon dioxide, was regularly evolved He remarks "the preparation of ethane in this way is as simple as that of any other gas" The work has been strangely overlooked (*C.R.*, 61, 487; 1865)

Some of us, having regard for patent facts, have long preached the doctrine, that the electrolysis of aqueous solutions is essentially an oxidation (hydroxylation) process Oxygen is commonly obtained because the peroxide first formed is decomposed at the electrode surface Any promoter of its breakdown, such as lead peroxide, necessarily prevents the appearance of the peroxide or of its immediate decomposition products In making acetic acid from aldehyde, on the large scale, during the War, the need of a manganese or other suitable salt to promote decomposition of peracetic compounds was clearly recognised, though not fully until after a serious explosion Textbooks have little regard for truth The fiction that hydrogen and oxygen are immediate products of electrolysis is a hardy chestnut we might well transfer to the dustbin no boy should be taught to use it as a Conqueror

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Passage of Hydrogen through Steel

I WAS much interested in the communication by T N MORRIS to NATURE of February 10, p 217, concerning the observations he has made relating to the diffusion of hydrogen through steel Since he asks whether facts of the kind he mentions have been previously recorded, may I make the following observations ?

The diffusion of hydrogen through mild steel under varying conditions of temperature and acid concentration formed the subject of a paper which was published (under my name) in the *Journal of the Iron and Steel Institute*, vol 2, 1925 This paper dealt with a quantitative study of certain aspects of this interesting problem, but it was by no means the first time that the phenomenon had been observed So far back as 1874, Osborne Reynolds directed attention to it in a paper he published in the *Memoirs and Proceedings of the Manchester Literary and Philosophical Society*, vol 13, p 93

C A EDWARDS

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Feb 9

Side-Chain Reactions of Benzene Derivatives

WE have recently examined a number of side-chain reactions in the light of the postulate that the differences in the rates of reaction of a series of similarly constituted compounds under identical conditions are to be ascribed solely to different energies of activation, substituents contributing additively to the total energy[1] Our results[2] for the reaction of hydrogen ion with various *p*-substituted acetophenones $X\,C_6H_4\,CO\,CH_2R$ (acid-catalysed prototropy) indicate that the energies of activation are given by the expression $E = E_0 - C\,(\mu - a\mu^2)$, where C and a are constants for the series, E_0 is the value of E for the unsubstituted compound, and μ is the dipole moment of C_6H_5X. The substituents dealt with included three halogens, to which the equation applies accurately, but did not include 'inclined' groups such as $-$OAlk and $-NAlk_2$ We further suggested[3] that the expression $E = E_0 \pm C\,(\mu - a\mu^2)$ might be applicable to side-chain reactions in general, the negative and positive signs referring respectively to those of Classes A and B[4] A review of fourteen reactions led us to the conclusion that, for *m*-substituted compounds, the equation is valid except when the substituent is a halogen, while, with the substituent in the *p*-position, complications arise, as anticipated, from the operation of electromeric effects, and in a number of Class *B* reactions the term in μ^2 changes sign, an observation for which there was no obvious explanation.

We wish now to suggest that, while the equation $E=E_0-C(\mu-a\mu^2)$ applies to reactions of Class *A*, the correct expression for Class *B* reactions may be $E=E_0+C(\mu+a\mu^2)$. Assuming this expression, the halogens *as a group* behave in accordance with the dipole moments of C_6H_5X, while the 'inclined' groups are exceptional. The new view is based, in fact, on the probability (kindly pointed out to us by Prof. Ingold) that the 'effective polarity' of these groups is represented not by the measured dipole moment but by the component in the plane of the nucleus. The calculation of the angle of inclination for $-OCH_3$, from results where complications appear to be absent[5], gives the value 112° or 104.5°, according as the value of μ for anisole is taken as -0.8 or -1.2 Debye units. This may be compared with the angle suggested for singly-linked oxygen[6] and the vertical angle for water[7].

No clear distinction can at present be drawn between the possibility outlined above and that suggested previously, but it is hoped to obtain further information from experiments now proceeding at these laboratories.

W. S. NATHAN.
H. B. WATSON.

The Technical College,
Cardiff.

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[1] Compare Bradfield, *Chem. and Ind.*, 51, 254; 1932.
[2] *J.C.S.*, 217, 890; 1933.
[3] *J.C.S.*, 1248; 1933.
[4] Ingold and Rothstein, *J.C.S.*, 1217; 1928.
[5] Shoppee, *J.C.S.*, 696; 1932.
[6] Wolf, *Z. phys. Chem.*, B, 3, 128; 1929.
[7] Debye, "Polar Molecules", 1929, chap. iv. Mecke, *Z. Physik*, 81, 313; 1933.

The Infinite and Eternal Energy

THE quotation for which Mr. Donald Murray asks in NATURE of February 24 is in Herbert Spencer's "Principles of Sociology", Part 6—Ecclesiastical Institutions, Chap. 16—Religious Retrospect and Prospect. It there reads as follows: "But one truth must grow ever clearer—the truth that there is an Inscrutable Existence everywhere manifested, to which he [the man of science] can neither find nor conceive either beginning or end. Amid the mysteries which become the more mysterious the more they are thought about, there will remain the one absolute certainty, that he is ever in presence of an Infinite and Eternal Energy, from which all things proceed."

It first appeared in January 1884, when this chapter of the 'Sociology' was published as the first article in the *Nineteenth Century*. It was, I think, mainly responsible for the attack made upon Spencer by the late Mr. Frederic Harrison, the controversy between him and Spencer lasting almost throughout that year. In the course of the controversy, Mr. Harrison had referred to the Inscrutable Power as "the All-Nothingness", and Spencer replied in July: "So far from regarding that which transcends phenomena as the 'All-Nothingness', I regard it as the All-Being. Everywhere I have spoken of the Unknowable as the Ultimate Reality—the sole existence; all things present to consciousness being but shows of it." The entire controversy was issued in book form in America, at the insistent request of Spencer's American friend Prof. E. L. Yeomans, but an objection raised by Mr. Harrison so incensed Spencer that he wired to his New York publishers ordering the book to be withdrawn and the plates to be destroyed. It was unfortunate, for the whole incident made much clearer the positive aspect of Spencer's doctrine concerning the Ultimate Cause, as opposed to the negative aspect so unduly enlarged upon by his opponents.

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Feb. 26.

[Several other correspondents, for whose letters we cannot find space, have also identified the quotation.—Ed. NATURE.]

Uniformity in Bibliographic Particulars

IN the library of the John Innes Institution, and presumably in other scientific libraries, the indexing of 'separates' has become a formidable task. It is made more laborious where the particulars given of the source of the paper are misleading or incomplete. Editors will not, I am sure, be unwilling to consider the needs of the librarian, and I therefore venture on some suggestions.

First, the bibliographical particulars should be readily available on the cover or front page of the separate. (It is not necessarily the business of the person making the index cards to read the papers.) Secondly, no irrelevant matter should appear. The citation should be essentially as follows:

> Name of author, title of paper, year, name of journal, volume, page references. (The pagination should be unaltered.)

Although there are a number of journals which adhere to this standard practice, too many others deviate from it in one way or another. The most usual deviations are the following:—

(1) Separates are sent out in blank covers, or in covers bearing the name of the journal but no other particulars.

(2) The title, etc., is given on the cover, but the page references omitted.

(3) The name of the journal is followed by the day, month and year of publication, and the volume and page references omitted, or the session (in the case of *Proceedings*) is given, and the year omitted.

(4) The paper is re-paginated, and the original page references not only omitted but also unascertainable.

(5) The cover is like that of the parent journal, and the name of the author of the paper either has to compete with that of the editor of the journal, or does not appear on the front page at all.

To take these points in order: (1) may be due to economy, which does not permit of a separately printed cover. It would cost no more and would suit most of us better to have such a paper without a cover, but with full particulars at the head of the first page. (2) is due to lack of foresight, as it is scarcely any more trouble for the printer to add the page references when printing the title, but in their absence *every* recipient of the separate who keeps a card-index has to waste time looking inside. (3) shows a lack of foresight that is even more depressing, as one cannot cite the complete reference without undertaking bibliographical research on one's own account. As the reprints are meant to reach those who do not see the journal, it seems indeed thoughtless to give on them a citation which cannot be completed except by reference to a file of the journal. The same applies to (4). In (5), which is due to excess of zeal, the author's name if it appears at all is coyly hidden between those of the editor and publisher (as in the case of the railway station which was called Bovril). This at the best is distracting to the eye, at the worst, in the hands of an assistant who is not very strong in foreign languages, it can lead to quite remarkable results in the filing.

Thirdly, on the more general question of bibliography, apart from the immediate one of separates, journals have various idiosyncrasies. There are for example some which begin over again at p. 1 for each part within the volume, or have separately paginated appendices. Surely the volume should always be the unit. There is one venerable and distinguished London journal sent out in continuously numbered parts, the volumes are made up of an irregular number of these parts, but there is nothing on the cover to show which part begins or ends a volume. Then there are a great many journals which still use roman numerals, a quaint but eye-straining practice. There is the confusing trick of numbering the plates, including their versos which are always blank, along with the text, and finally there is the practice of putting last year's date on an overdue part. Such falsification of a document is scarcely an example of scientific integrity.

To conclude, it is evident that many journals which are scientific in content are traditional in form. It may be that there are certain advantages, of which I am unaware, in the practices which I deprecate, but it seems more likely that they have persisted, not on account of any essential virtue, but simply because it has been no one's business to have them altered. The eminent men of science who conduct the journals may consider such small matters unworthy of their attention, but convenience and consistency underlie all scientific method and might well be applied in this case as in others.

BRENHILDA SCHAFER
(Librarian).

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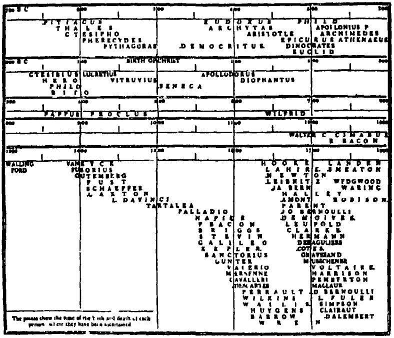
Jan. 1.

Graphical Determination of Contemporaries

THE illustration which Mr. Lucas gives of his graphical determination of contemporaries[1] is perhaps an unfortunate one, for even with the help of this example his letter affords no clue as to what he is trying to do or why he has chosen an oblique method of doing it.

The duration of a life is very simply represented by the length of a line or, better still perhaps, by the interval between two points and it would seem that the interesting chronologies[2] of Prof. Thomas Young are admirably adapted to the determination of contemporaries.



The points show the time of the birth and death of each person where they have been ascertained

FIG. 1.

In referring to the Chronology of Mathematicians and Mechanics, reproduced in Fig. 1, I was interested to read, on the facing page, Young's counsel of perfection to everyone who is desirous of enlarging the sphere of our knowledge with respect to any branch of science "to collect that previous knowledge of all that has been already done with the same view, which, in justice to himself, he ought to acquire before he enters on the pursuit, or at any rate, in justice to the public, before he calls on the world at large to participate in his improvements and discoveries".

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Jan. 30.

The Viability of Spirochætes dried in Vacuo

IT is well known that all kinds of spirochætes, both pathogenic and non-pathogenic, are unable to withstand ordinary desiccation, for repeated experiments have shown that they very soon lose their vitality after ordinary drying. Hitherto, however, no attempts seem to have been recorded on the results of drying these organisms by the special methods used with success for the preservation of certain filterable viruses and some bacteria. In view of the difficulty and expense of maintaining strains of spirochætes in the laboratory, it seemed of interest to see whether they could be preserved in the same way, and the results show that under special conditions it is possible to dry them without destroying their vitality.

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[1] NATURE, 133, 141, Jan. 27, 1934.

[2] Young, T., 'A Course of Lectures on Natural Philosophy and the Mechanical Arts', London, 1807.

Five strains of spirochætes have been used in these preliminary experiments, two culture strains of *Spirochæta pallida* obtained respectively from Kroo and Vasarhelyi, and three strains of *Spirochæta biflexa*, the common water leptospira, two Leyden strains obtained from Schuffner and van Theil, and a strain which I have recently isolated from London sewage. Extremes types of spirochætes were thus included, for *Spirochæta pallida* is somewhat exacting in its cultural requirements and in addition to being very susceptible to variations in the media, normally requires subculturing every week, whilst *Spirochæta biflexa* is much more resistant and, at room temperature, cultures will remain positive for some months

About 0 5 c c of a rich suspension of the spirochætes in their respective media, which both contained approximately 10 per cent of rabbit serum, was placed in each of a number of small sterile test-tubes. The tubes were then placed in a freezing mixture at −10° C until the contents had solidified, and then placed in a desiccator containing phosphorus pentoxide, and the air exhausted as quickly as possible The desiccator and its contents were then left in the ice chest and the desiccating agent renewed the following day and the air again exhausted After 15 days under these conditions, the dried contents of the tubes were inoculated into fresh culture media, and in every case the spirochætes were found to have remained alive The strains of *Spirochæta biflexa* seemed to grow more slowly than when ordinary motile spirochætes were used for inoculating the culture tubes, but in the case of the two strains of *Spirochæta pallida*, their rate of growth seemed to have been unaffected

Although at present the vitality of these spirochætes dried *in vacuo* has only been tested up to 15 days, there is no reason to doubt that they will remain alive for very much longer periods This method, therefore, should be of value for the maintenance of strains of spirochætes in the laboratory, as it reduces the necessity for repeated subculturing

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Insect Transmission of Spike Disease

IT has been recently announced[1] that transmission experiments with the Jassid, *Moonia albimaculata*, have yielded three positive results; that the symptoms so produced are inseparable from typically spiked plants on morphological, biochemical and cytological grounds

This important result was the subject of a discussion at one of the meetings of the Working Committee on Spike-Disease Investigation (July 28, 1933) when Dr V Subrahmanyan, in view of the fundamental nature of the finding, suggested that the result should be critically examined in all its aspects As a result of the discussion, it was felt that the evidence, based on symptomatic and other grounds, was by itself not sufficiently conclusive to justify the incrimination of *Moonia* as the vector of spike disease. It was therefore suggested that the matter should be regarded as *sub judice* pending the results of infectivity experiments by grafting, which was considered to be the decisive test in doubtful cases of disease.

It is well known that the sandal plant assumes a variety of morphological characteristics, some of which are often mistaken for the condition of spike. Experiments have shown that this condition can be brought on by deprival of host plants, an impoverished soil, drought and other adverse soil and climatic factors These symptoms can be distinguished from those of a genuinely spiked plant, are not transmitted to other healthy plants by grafting and can be made to disappear when the adverse conditions are removed

A typical spiked plant, however, is infective, the symptoms of the disease being communicable to other healthy plants through grafting, a technique which has proved most useful in determining the infectivity of doubtful cases of spike. It is the infectious character of the disease that renders the problem economically important and serious

It is clear from the above discussion that it is important to distinguish between the curable and non-infectious condition of stunting induced by an adverse environment, as against the deadly and infectious condition of spike disease, which, to an experienced worker, is not difficult to diagnose The following are results of grafting tests which have been carried out.

Leaves from	Number of plants operated	Number of plants spiked
Spiked plants	12	9
Insectary plants	14	0

They confirm the suspicion that the three plants alleged to be diseased only represented a stunted condition which was brought on by an impoverished soil, want of a vigorous host and probably aggravated by insect feeding The symptoms have not been transmitted through grafting, and further, the plants themselves, after a careful nursing with fresh soil and host, have since turned completely healthy

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Jan 18

[1] NATURE, 132, 592, Oct 14, 1933

Bilateral Gynandromorphism in Feathers

MR PAUL 'ESPINASSE has recently pointed out[1] some difficulties preventing complete acceptance of the growth rate theory of Lillie and Juhn[2] in which bilateral gynandromorphism of individual feathers is supposedly explained. The existence of differences in rates of growth of individual barbs, by which these authors explain different degrees of susceptibility to female hormone, would be proved if, in successive cross sections of a feather, barbs arising near the ventral point fused with the rhachis at a higher level on one side than on the other, but this has never yet been observed

The concrescence theory of development of a feather, in which the rhachis is regarded as formed from two halves of a collar (the growing basal region) is also due to these authors, but this interpretation, necessary for an explanation of the growth rate theory of Lillie and Juhn, is not in agreement with the results of Davies[3] and Strong[4].

According to the present investigation, the formation of ridges in a feather follows, and is probably due to, the rapid proliferation of intermediate cells causing increased pressure on the pulp, while lateral expansion is prevented by the sheath Those ridges proceed in a curve round the feather germ, so that ultimately the ridge nearest the ventral point lies dorsally There is no suggestion of a movement of cells from one position to the other --rather a passive cutting up of the intermediate cell layer

The rhachis has a complex origin, as Davies and Strong agree, but which Lillie and Juhn consider incorrect Sections through the tip of a feather show a ring of barbs, with little or no difference in size between the ventral and dorsal ones This is particularly evident in embryonic feathers Successive cross sections down the feather show the fusion of barbs to form the rhachis

The hyporhachis is formed in the same way, the ridge nearest to the ventral point fusing with its neighbour as do the ridges near the dorsal point in forming the rhachis The calamus is merely the cornified collar, as though the process of cornification, having gained speed in passing down the feather (correlated doubtless with the withdrawal of pulp) is here too rapid for the formation of ridges

In view of this method of development of individual barbs, it is difficult to correlate the appearance of female bars on one side only of an otherwise symmetrical feather, with differences in growth rate of the barbs Barbs certainly grow more quickly at their apices, where they are smaller in cross section than near the rhachis—hence the upward curve of barbs in a definitive feather. But barbs of equal length at any level must of necessity have arisen at the same time near the ventral side of the germ Some other explanation, therefore, must be advanced for a correct interpretation of the female bar in the feathers figured (Nos. 51 and 52) by Lillie and Juhn

A re-examination of feather development is obviously necessary for an accurate explanation of known experimental facts, and it is hoped, during the summer, to publish the results of a study, now nearing completion, of the development of nestling and definitive feathers in the domestic fowl and the duck, and of definitive feathers in the starling

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[1] NATURE, 133, 330, March 3, 1934

[2] "Physiol Zool", 5, 1932

[3] "Morph Jahr", 15, 1899

[4] *Bull Mus Comp. Zool Harv*, 40, 1902

Effect of Yeast Extract on the Growth of Plants

WE have read with great interest the communication by Prof V Subrahmanyan and G. S. Siddappa in NATURE[1] under this title, in which the authors state that in 1932–33 several Indian papers published results of their experiments, in which yeast extract was injected into plants with a marked effect on the growth and blooming. Unfortunately, we were hitherto completely unacquainted with this interesting work and, consequently, were unable to refer to it in our previous paper on the subject[2].

Our work was carried out in 1932–33, and differs substantially from the observations of Subrahmanyan and Siddappa, as we showed that plants are able to take up the promoting factor (or factors) in the yeast extract, through their roots. In our opinion, this is of great interest, since it tends to show that the micro-organisms in soil are of importance in the formation of different growth-promoting factors Soil micro-organisms would thus have functions previously unforeseen.

Further to our earlier note, we have found that the factor which stimulates the blooming of the pea is soluble in ether (communication to a meeting of the Society of Finnish Chemists on November 4 last) The extract is equally effective in sterile water cultures and in the usual pot cultures with quartz sand

Pot cultures with different types of soil showed that in clay soil the effect of yeast extract on the growth of the pea was still distinct, although not so marked as in quartz sand. In rich humus soil the effect was very weak or possibly nil This could be explained by assuming that the stimulating factor of yeast extract is normally present in soils rich in organic matter and with an abundant microflora

A detailed report of our work on the subject will appear elsewhere

A. I VIRTANEN
SYNNOVE V HAUSEN

Biochemical Institute,
Helsingfors Jan 26.

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[1] NATURE, 132, 713, Nov 4, 1933

[2] NATURE, 132, 408, Sept 9, 1933

The Age of the Sub-Crag Implements

I AM glad that Prof Boswell[1] has expressed an opinion upon the nature of the material attached to the surfaces of a rostrocarinate flint implement exhibited, recently, in the British Museum There are few people for whose views upon such a matter I entertain more respect, and I intend, if he will allow me, to go further into the question of this particular implement with him, and of that of others I am in process of collecting from beneath the Red Crag It is evident that we are dealing with a complex matter in which Prof Boswell's specialised knowledge of Crag deposits will be of great value

As regards the geological age of the boxstones, I find that Lankester, who made a very close study of these specimens, and, in fact, gave to them their characteristic name, states[2] that they are "The Remains of a Pliocene deposit, anterior to the Coralline Crag, and identified by its fossils with the Black Crag, or Diestian Sands of Belgium", while in Clement Reid's "Pliocene Deposits of Britain", p 223, the "Sables à *Isocardia Cor*, or Diestian" of Belgium, are placed by him in what he calls the "Older Pliocene" Also, in the Survey Memoir "The Geology of the Country around Woodbridge, Felixstowe and Orford", p. 16, Prof Boswell himself states "Although the boxstone fauna has been compared with the Continental Miocene, or even with the Oligocene (Rupelian), it is at present generally regarded as of Lower Pliocene Age" It was for these reasons that, in my recent note in NATURE[3], I stated that the Diestian boxstones are referable to the Lower Pliocene epoch But, in the note mentioned, I made no claim that the British representatives of the Continental Diestian deposits are the boxstones of Suffolk. I merely, like Lankester, look upon the boxstones as representing, in the Suffolk Bone Bed, the Diestian Sands of Belgium.

J. REID MOIR.

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[1] NATURE, 133, 331, March 3, 1934.

[2] *Phil Trans*, B, [illegible], 291.

[3] NATURE, 133, 64, Jan. 13, 1934.

Research Items

Indian Iconography. Tours of inspection in Bengal districts by Mr. H. E. Stapleton, Director of Public Instruction, N. Chakravarti and S. K. Saraswati, have produced data of historical and archæological interest which are recorded in three communications (*J. and Proc. Asiat. Soc. Bengal*, New Ser., 28, No. 1, 1932). In the district of Dinâjpur along the Chirâmati River, in particular, Mr. Saraswati found interesting sculptures among figures worshipped at local shrines which have furnished details of importance in Hindu iconography. In the village shrine of Dohâbandh was found a sandstone *lingam* of very rare iconographic character. It is encircled by four effigies of the Devî, which have matted hair and are seated in the *padmâsana* attitude with clasped hands held up in adoration. The female figures around Siva's symbol evidently stand for his female energies. At Mahendra a previously unknown iconographic specimen was obtained. This is an image, probably of Sûryya, on the pedestal of which are the seven horses and the chariot; above are all the usual attendants, Dandî, Pîngala, his two queens, etc. All the figures are booted as is usual with the image of Sûryya. The interesting feature is that Sûryya has six hands instead of four or the more usual two. The two main hands hold lotuses by the stalks as prescribed, the others show respectively the gestures of 'granting boons' and 'granting security', one holds the rosary and another the pot. Nowhere are six hands mentioned or shown, nor are the rosary and pot known as his attributes. The image seems to correspond to a description of Dhâtri, the first Âditya, except for the two additional hands. This is perhaps the first iconographic treatment of such a deity yet discovered. At Betnâ a female figure fighting with a host of pot-bellied Asuras is evidently an aspect of Chandikâ fighting the demons. She holds various weapons in thirty-two hands, but in spite of the large number of additional arms, the figure is masterful in its life and reality.

Prehistoric Goats of Poland. In a neolithic settlement in the commune of Zlota, Poland (dated 2500–2000 B.C.) remains of domestic goats have been found, and M. K. Wodzicki identifies the fragments as belonging to the *Capra prisca* type (*Acad. Polonaise Sci. Lettres*, 1933, p. 89). The skulls and horns show a considerable amount of variation, but there is no indication that any other species was domesticated. Fragments which have been described from fifteenth and sixteenth century settlements in Poland and from early historic sites also belong to *C. prisca*-typus, although in the Middle Ages two races can be distinguished by the compactness or divergence of the horns, and in the early ages the horns are distinctly smaller and their slope markedly divergent.

Hydrography of an Indian Tank. Dr. Hem Singh Pruthi has made a detailed study lasting over three years of the seasonal changes in the physical and chemical conditions of the waters of the tank in the Indian Museum compound ("Studies on the Bionomics of Fresh-waters in India (1)", *Internat. Rev. Hydrobiol. Hydrographie*, 28, Hft. 1–2, 1932). In the tropics, growth is more rapid and decay is more sudden than in temperate regions; also, because of the great amount of evaporation and consequent rainstorms, the condition of tropical waters is altered more in a few hours than in many days in temperate regions. It was found that there was a complete mixing of surface and bottom waters in January, the upper layers after this becoming warmer and a thermal stratification beginning which is complete in April. The *p*H value has two maxima in the year, in spring and in autumn, the latter being higher than the former. The changes in the *p*H value seem to be connected with the photosynthetic activity of the chlorophyll-bearing organisms, which depends on the weather and the amount of necessary salts available. If the weather is fair, the surface water is generally saturated with oxygen after 10 a.m., but the bottom water is always deficient in oxygen. The surface layers are replenished in salt content partly when the thermal stratification is disturbed during the monsoon or when the waters mix in January, but chiefly by the rain-water laden with salts which flows into the tank from the high banks during the rainy season.

Morphology of the Insect Abdomen. The writings of Mr. R. E. Snodgrass on insect morphology are well known to all students of entomology. In his most recent contribution entitled "Morphology of the Insect Abdomen" (*Smithsonian Misc. Coll.*, 89, No. 8; Oct. 1933) he continues his previous memoir on this subject and, in the present instance, deals with the genital ducts and the ovipositor. He concludes that the primitive gonoducts were paired mesodermal tubes each opening to the exterior by a separate pore. These pores were located on the 7th abdominal segment in the female and on the 10th segment in the male. In most insects, as we know them to-day, a median ectodermal passage has developed and become connected with the primitive ducts. This has resulted in the acquisition of a single genital pore which opens between the 9th and 10th segments in the male, while in the female it is more variable in position since it may be located on the 7th, 8th or 9th segments. In dealing with the structure of the ovipositor, Mr. Snodgrass's account is illustrated by a wealth of original figures portraying the structure of the organ and its associated musculature in different groups. While in many Orthoptera the ovipositor is formed by three pairs of valvules, in the Gryllidæ and Acrididæ only two pairs are evident, namely, the 1st and 3rd, the 2nd pair of valvules being vestigial. On the other hand, in the Thysanura, Hemiptera and Homoptera, the ovipositor is likewise formed of two pairs of valvules, but in these cases it is the 1st and 2nd pairs that compose the organ. The memoir is too detailed to allow of more than brief mention and is one of general interest to students of insect morphology.

Protein Metabolism in Wheat in Relation to Nitrogen Supply. In a study of the distribution of nitrogen in wheat plants grown in water culture, A. G. McCalla (*Canadian J. Res.*, 9, 542, 1933) finds that altering the nitrogen supply does not materially affect the amount of protein in the plants, though with low nitrogen supply there is a marked reduction in the amount and proportion of non-protein nitrogen and, in particular, a much lower proportion of amide nitrogen. These effects are not, however, observable in the seeds, where low nitrogen supply reduces the total nitrogen present, but does not cause any significant variations in the proportions of protein and non-protein nitrogen. The proteins of the seeds, on the other hand, possess lower proportions of amido nitrogen and higher proportions of mono-amino nitrogen when nitrogen supply is low. Finally, the low-nitrogen seeds contain a much smaller proportion of gluten than do those supplied with abundant nitrogen. In both sets of seeds, the physical properties of the glutens and the ratio of alcohol-soluble protein to alkali-soluble protein appear to be identical. The author concludes that differences in nitrogen nutrition do not produce any essential difference in the quality of the kernels except those due to varying amounts of gluten. The variations in quality of grain of any variety of wheat grown under field conditions are, therefore, due to other factors.

North Pennine Ore Deposits. The well-known mineral fields of Alston Moor and Upper Weardale have been studied in detail by Dr. K. C. Dunham (*Abs. Proc. Geol. Soc.*, p. 47, 1934). The mineralised area is divided by the faulted monocline of Burtreeford into two crudely circular areas within each of which the minerals are distributed laterally and vertically in well-marked concentric zones. Three zones of gangue minerals are recognised: a central fluorspar region (281 veins), a broad peripheral fringe of barytes, with local witherite (208 veins); and an inconstant transition belt (17 veins). From each centre the successive sulphide zones are characterised by (1) notable amounts of chalcopyrite, (2) galena with subordinate zinc blende, (3) galena and zinc blende in roughly equal amounts, and (4) galena alone, blende falling off rather abruptly. Sulphides die out beyond the galena zone and the veins become almost entirely barytic. The zonal arrangement is superimposed on the Carboniferous formations and the Whin Sill with complete impartiality. This marked independence of distribution serves to dismiss the old lateral secretion hypothesis, and to prove that the Whin Sill was not directly concerned with the mineralisation. It is suggested that the ores were introduced by hydrothermal solutions derived from certain deep-seated foci of intrusion (each corresponding to a dome of mineralisation), of which the representative igneous rocks have not yet been revealed.

Initial Motion of Earthquakes. Two years ago, Mr. T. Fukutomi noticed a similarity in the direction of the initial motion of earthquakes in certain parts of the Kwanto district, Japan. He has recently studied the distribution of earthquakes with similar initial directions of motion with fuller materials (*Bull. Earthq. Res. Inst.* 11, 510-528, 1933), using earthquakes with distinct initial vertical motion in Tokyo from 1914 until 1932 and originating within 100 miles of the city. The total number of such earthquakes is 337, in 176 of which the initial motion was upward and in 161 downward. The epicentres of earthquakes with the same initial direction are grouped in rather definite areas. Thus, the earthquakes originating beneath the basins of the Rivers Kinu and Ogai, the southern part of the Boso peninsula, in the Idu peninsula, etc., begin with an upward movement at Tokyo; those in the Kasugaura, along the shores of Tokyo Bay, and in the central part of the Boso peninsula, with a downward movement. The writer concludes that the earthquakes originating in the two main regions are due respectively to similar modes of origin.

Tuning Fork as a Standard of Frequency. A paper by the late Dr. Dye and L. Essen has recently been published on the valve-maintained tuning fork as a primary standard of frequency (*Proc. Roy. Soc.*, A, Feb.). The fork used has a massive base and prongs cut from a bar of elinvar and has been in use since 1922. The effect of changing a number of variable factors on the period of the fork has been investigated. The period is independent of the exact way in which the base is clamped only if the prongs are accurately balanced, and a method for doing this is described. The variation with polarising magnetic field, with amplitude, atmospheric pressure, and with the voltages and loadings applied to the driving circuit were all studied and a design for the fork equipment evolved. The residual instability of this arrangement was mainly due to small changes in the voltages applied to the valve circuits and to changes in pressure within the fork enclosure. With improvement in the conditions, the fork is expected to show a long period constancy of one part in 10^7 and a short period constancy of a few parts in 10^9. It is stated that a small reaction occurs between the fork and another oscillator used for comparison; this might be avoided by the appropriate use of screen-grid valves.

Polarographic Researches. The phenomena associated with the deposition of metals at the dropping mercury cathode have been the subject of investigations during the last few years by Prof. J. Heyrovský and his co-workers. Recently the method has been extended to micro analysis. Thus, it has been successfully adapted to the estimation of iodine in Chile saltpetre, the analysis of petroleum distillates for reducing agents and in the electro-reduction of many organic compounds. The way in which the platinum elements lower hydrogen overvoltage has also been demonstrated by the polarographic method. A further illustration of its diverse applications is afforded by its use in biological investigations on the adsorption factor of serum and on the lymph in cutaneous diseases, in which the dermatologist, Dr. Petráček, made good use of the method. Perhaps the most striking results obtained with the polarograph are those of Dr. Brdička, who has studied the catalytic action of cobalt ions upon protein decomposition. It is found that the protein content of a fraction of a milligram of material can be estimated by this means. The amount of cysteine in a millimetre of hair has been determined and, apart from its analytical value, Brdička's work has an important bearing upon the elucidation of the co-ordinating properties of polypeptides and their decomposition products. For Czech readers, Prof. Heyrovský has just compiled a monograph summarising the applications of the polarographic method in practical chemistry under the title, "Použití Polarografické Methody v Practické Chemii" (Pp. 132. Published by the Czechoslovak Society for Research and Testing of Materials, Prague III). The monograph, which deserves to be translated into English, gives a comprehensive account of the researches carried out with the polarograph. The bibliography contains 139 references.

Social and Industrial Development of Rural Communities

THE twenty-third report of the Development Commissioners[*] for the year ended March 31, 1933, is much more than a mere collection of official statements of the various activities directed by the Commission. The report no longer sets forth the work in progress at research institutes and advisory centres in Great Britain, as this will be dealt with in the publications of the Agricultural Research Council and the departments of agriculture. Brief accounts of the institutes are given, touching on their *raison d'être*, personnel and finances, but the chief emphasis is laid on the progress of various schemes which the general public scarcely realises as coming within the scope of the work of the Commission.

In most rural districts in Great Britain, very slow progress has been made by electrical supply schemes, as the cost has been beyond the reach of most rural dwellers, largely because of the distance that current has to be conducted as compared with urban areas. Special arrangements were made to supply a rural area in Bedfordshire with electricity under special terms, and considerable progress has been made during the three years of the scheme. The majority of rural customers use electricity for domestic purposes only, but its use in farm buildings and dairies is gradually spreading, and about 62 per cent of all the premises within the area are now receiving supplies. The most important factor responsible for the progress made seems to be the adoption of a lower tariff than in most rural areas, together with special facilities offered by the Bedfordshire Corporation for assisted wiring without consumption guarantee. It is anticipated that by the end of 1934 revenue from this source will exceed expenditure and yield surpluses from which the advance from the Development Fund will be repaid.

For the last twelve years, the Rural Industries Bureau has been working largely for the benefit of local craftsmen, in association with the National Council of Social Service, the Rural Community Councils and Women's Institutes. Progress was at first slow, partly because of the difficulty of establishing contact with isolated village craftsmen, and partly because such craftsmen viewed the activities of the Bureau with suspicion and failed to realise that it had any value in putting them into touch with the work they needed so badly. Now that confidence has been established, about two thousand craftsmen are in touch with the Bureau's officers, but it is probable that at least three times as many have not yet been reached. The activities of the Bureau are multifarious; craftsmen are trained to make such things as fine ironwork, good furniture and substantial fruit baskets; local textile industries are reviewed and their products adapted to present-day requirements; exhibitions are staged at county shows and local fairs, and every endeavour is made to bring the craftsman into touch with a market for his productions. In general, both the purpose and policy of the Bureau may be summed up in the words, the "Craftsman's Friend".

For some years the Society of Friends has given special attention to allotment cultivation as a means of alleviating distress. In 1930, Government granted £80,000 to the Ministry of Agriculture towards aiding the provision of allotments for the unemployed, but after the financial crisis in 1931 this grant was not continued. However, the Society of Friends decided to carry on the work itself and to obtain money by public subscription. Its efforts were so successful that the 1933 programme catered for providing 100,000 persons with allotments, and Government assistance was applied for. The application was referred to the Development Commissioners, who recommended a grant of £10,000 on the £1 for £1 basis, and a further sum not exceeding £2,500 on the basis of £1 for each £2 raised by the Society of Friends. Certain conditions were laid down as to the application of the grant, which included Scotland in its scope. In actual practice, the cost of carrying out the scheme for the cropping year 1933 worked out substantially below the estimate, chiefly owing to the low price of seed potatoes.

On the fisheries and harbours side, much progress has been made in the extension and improvement of the breeding of shellfish. A simple and effective method has been evolved of rendering mussels and oysters contaminated by sewage clean and safe for human consumption, by placing them in tanks of sea-water made sterile by the addition of minute quantities of chlorine, which is afterwards removed so as to allow the shellfish to function freely. The investigations on the furunculosis disease of salmon, sea trout and fresh water fish have advanced considerably, but show that there are formidable difficulties in preventing the spread of the disease.

The diverse instances touched on above indicate the wide range of social problems dealt with by the Development Commissioners and demonstrate very clearly the value of their activities in connexion with many and varied aspects of national life.

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[*] Development Commission. Twenty-third Report of the Development Commissioners, being for the Year ended 31st March, 1933. Pp. 107. (London: H.M. Stationery Office, 1933.) 2s. net.

Recent Researches on Fuel Technology

ANYONE casting his mind back for twenty years cannot fail to remark on the greatly increased interest in the problems of manufacture and utilisation of fuels. This is largely, although not entirely, a legacy of the War and its interruption of normal supplies, the rise of economic nationalism and the lesson of what could be achieved by the purposeful application of science. Early efforts were individual, in private concerns or educational institutions, but all over the world, State action has followed; for example, the British Fuel Research Board was established to study the production of liquid fuel for the Navy by the carbonisation of coal at low temperatures. Experience soon showed that no immediate solution lay in that direction, and the Report of the Board for the year ending March 31, 1933 (H.M. Stationery Office, 2*s*. 6*d*. net) shows that this aim is still unattained, although retorts of new design are giving promising service.

A limited quantity of oil and spirit from low-temperature tar has been supplied commercially to

Government departments during the last year. Experience has shown that low-temperature tars are particularly susceptible to a hydrogenation-cracking and some can be converted into motor spirit with a yield of nearly 100 per cent by volume, the tar acids being eliminated. Private concerns have accumulated much experience with the hydrogenation of coal and oils but their experience is not available. This adds to the interest of the Board's experiments on the mechanism of hydrogenation.

It has been shown that minute quantities of certain catalysts, for example, 0·067 per cent of some tin compounds, are effective. This emphasises the importance of the inorganic constituents of coal, and coal ashes are being examined spectroscopically to find whether coals exist containing germanium. Such observations stress the importance of the Physical and Chemical Survey of National Coal Resources, perhaps the most important branch of the Board's work, which now covers all the British coalfields. The rôle of the State in the prosecution of fuel research has its critics, but it must be allowed that private enterprise has failed to accumulate and provide the consumer with reliable information about the properties of its wares. Indeed it is a remarkable fact that the Survey has been established against the hostility of less enlightened coal-owners. Another notable item in the report is the publication of a collection of 365 analyses of commercial grades of coal raised in the South Yorkshire area. Actually this is a most useful publication, but in most industries, private concerns bear the cost of supplying the tests of their own commercial products.

The systematic survey not merely shows what is available underground but also suggests at times how the product can be improved by modifying the methods of working the coal. The Survey has confirmed the assertion that British coal seams are among the finest in the world and that with attention to the preparation for the market the product can meet any competition for quality.

Domestic fuel forms a big item in the national fuel bill, and work of general interest is reported. Many consumers can try for themselves the suggestion of making packets lined with aluminium foil containing coal slack. These, when placed on an open fire, hold together long enough to allow the coal to coke and then burn as a lump fuel.

These are a few items from the many investigations mentioned in the report, which covers practically the whole field of fuel technology. Certain investigations in university and other laboratories are also being supported financially, but on a reduced scale as a measure of national economy. H. J. H.

Cosmic Rays

KOLHÖRSTER has recently published a critical discussion of the nature of the cosmic rays (*Phys. Z.*, Nov. 15). He points out that the cosmic rays may be investigated by the use of the ionisation chamber, the Geiger counter or the cloud chamber. The distribution of the ionisation in latitude shows variations which indicate that some at least of the rays are particles which can be deflected by the earth's magnetic field. A small azimuthal asymmetry has been detected which may indicate that an excess of the incident particles are positively charged.

Magnetic deflection experiments have not led to unambiguous results. The rays appear to be very fairly constant in intensity, though periodic variations of the order 2 per thousand may possibly occur during the sidereal or the solar day. The variation with barometer, due to absorption in the atmosphere, is well marked, and tends to obscure lesser variations. From time to time large bursts of ionisation are observed (*Stösse*) which are presumably of secondary origin. The curve connecting ionisation with height in the atmosphere has been repeatedly obtained up to the tropopause and some data exist at higher altitudes. The absorption of the radiation in water has been investigated. When the rays pass into a heavy absorbing medium, there is an anomalous variation in the absorption coefficient which indicates the production of a secondary radiation, and the production of such radiation is indicated by experiments with multiple coincidences of Geiger counters. The author concludes that the primary radiation is probably of corpuscular type. There is a long and useful, though incomplete, collection of references to the literature.

In the same number of the *Physikalische Zeitschrift*, Regener describes new measurements of cosmic rays in the stratosphere using his beautiful self-registering electroscope, while the *Journal of the Franklin Institute* of December 1933 contains an account of the photography of the *Stösse* by a Wilson chamber method. G. L. Locher arranges the Wilson chamber so that it is fired automatically by the discharge of three non-collinear counter-tubes. The showers observed often appear to originate at two or more points and must apparently be initiated by non-ionising secondary radiation, since their origins are frequently not collinear. There are also short tracks which are similar to those produced by recoil atoms from neutrons.

Index of Business Activity

IN a paper read before the Royal Statistical Society on January 16, Mr. Geoffrey Crowther described the "Index of Business Activity" which has recently been prepared by the *Economist*. Mr. Crowther pointed out that, up to the present, it has not been possible to measure statistically the amplitude of fluctuations in the general activity of the community. Indices of production are familiar in most countries and in the absence of a more suitable index, they are frequently used as indications of business activity, though they have obvious weaknesses for this purpose.

Productive industry is still the foundation for all economic wealth, but the superstructure of distribution and service is yearly growing in size and importance. Moreover, it is a well-known economic phenomenon that the swings in activity in productive industry are considerably greater than the fluctuations of the economic life of the community as a whole.

An index of business activity must therefore cast its net far wider than industrial production. It must take account not only of the rate at which goods are produced but also of the rates at which they are distributed, transported and sold

The *Economist* Index of Business Activity
(Average for Year)

1920	97·8	1927	107·8
1921	74·5	1928	105·9
1922	88·8	1929	110·0
1923	94·4	1930	105·9
1924	100·0	1931	96·3
1925	101·8	1932	95·8
1926	93·6	1933*	99·5

* Provisional, 11 months average

The *Economist* "Index of Business Activity" is published monthly and is based on a weighted series of indices relating to employment, the iron and steel and cotton industries, imports of raw materials and non-ferrous metals, exports of manufactures, railway traffic, shipping movements, consumption of coal and electricity, postal receipts, bank clearings, building activity and the registration of motor vehicles

History of Mathematical Time

TWO articles under the above title by G Windred have been published in *Isis*, 19 and 20, in 1933 In the first the author traces the development of the concept of mathematical time from its origins with Napier, Barrow and Leibniz up to the theory of pure time of Sir William Rowan Hamilton. Within the short space of some thirty pages, the author gives an excellent account of Barrow's theory of mathematical time, which formed the basis of the time concept in Newtonian mechanics for more than two centuries. He traces the progress of the concept in the writings of Newton, Maclaurin and Kant, and concludes with a brief account of Hamilton's views on algebra as the science of pure time.

The second article is devoted to the history of time in the mathematical physics of the twentieth century. The author gives a brief account of the fundamental papers of H A. Lorentz, Poincaré, Einstein and Minkowski concerning 'local' time, simultaneity of events and the synthesis of space and time into one whole in the special theory of relativity. He passes on to a relatively full account of Robb's theory of 'conical order' and concludes with brief references to the later work of Einstein, the system of time due to A. N. Whitehead, the views of Eddington, Vasiliev and Synge, and recent ideas on the atomic structure of time, due principally to Robert Lévy and Pokrowski. Here one misses any reference to the writings of H. Reichenbach, more particularly his "Philosophie der Raum-Zeit-Lehre", 1928, where a good deal of space is devoted to a discussion of the nature of time. Apart from this omission this part of the essay gives a clear and relatively full account of the changes brought about by the advent of the theory of relativity in our ideas of time. The last section of the essay gives a summary of the applications of the theory of time to mechanics and mathematical physics and of its implications for philosophy and psychology.

The essay can be highly recommended to anyone, whether mathematician, philosopher or physicist, who needs a brief summary of the history of the concept of time from its origin to its latest developments. It is well supplied with references and so can serve as a guide to anyone desirous of studying the question more completely than is possible in so short an essay.

University and Educational Intelligence

CAMBRIDGE.—The Buildings Syndicate recommends that the vacant site between the Museum of Archæology and Ethnology and the Botany School be assigned for an extension of the Museum, provided that this assignment be reconsidered if no permanent building is erected on the site within ten years.

The Council of the Senate recommends that a pension of £430 a year be granted to Prof J. T. Wilson on his retirement from the professorship of anatomy

The Faculty Board of Medicine recommends the establishment of a Marmaduke Shield scholarship in human anatomy of the value of £100 a year.

OXFORD.—In Congregation on March 3, the degree of D Sc was conferred on Charles K Meek (Brasenose College), Government anthropologist in Nigeria, and author of three important works: "A Sudanese Kingdom" (1931), "Tribal Studies in Northern Nigeria" (1931), "The Northern Tribes of Nigeria" (1925)

ADULT education is being exploited in the United States on a vast scale by the Federal Emergency Relief Administration as a means of providing work for unemployed teachers (including many unemployed persons who are potential though not professed teachers) and at the same time raising the standard of employability of the general mass of unemployed Any person now on relief or urgently in need of a job, who is a college graduate or able to offer other proof of intellectual ability, is to be given an opportunity of employment as teacher. The scheme has six divisions, of which two are outside the field of adult education: teaching of 'illiterates', which is construed to mean education of adults up to sixth-grade level, general adult education, trade schools, training of physically disabled persons, reopening of rural schools closed for want of funds to pay teachers, and nursery schools in mining camps, mill villages and other places where children, especially children of the unemployed, are not being adequately cared for. It is anticipated that where the local organisation is slow in developing a general adult educational project, a competent unemployed scientific worker will work up a class for himself to teach, whereupon he will be enrolled as a paid instructor. The rates of payment have been revised, the former limit of 15 dollars a week having been withdrawn The trade schools will provide employment for many engineers thrown out of work by industrial depression and the nursery schools will absorb some of the unemployed women trained in child psychology or kindergarten. *School and Society* of December 2 has an authoritative leading article describing the scheme.

Science News a Century Ago

Darwin in the Falkland Islands

Between March 10 and April 7, 1834, H M S. *Beagle*, for the second time, was in the Falkland Islands, and on March 16–19 Darwin made an excursion inland with six horses and two Gauchos, "dexterous hands in all the requisites of making the camp life comfortable", who to Darwin's surprise made a fire, nearly as hot as a fire of coals, with the bones of a bullock lately killed but from which all the flesh had been stripped by vultures Describing the Islands in his "Journal of Researches", the archipelago, he said, "is situated in nearly the same latitude with the mouth of the Strait of Magellan , it covers a space of one hundred and twenty by sixty geographical miles, and is little more than half the size of Ireland After the possession of these miserable islands had been contested by France, Spain and England, they were left uninhabited The Government of Buenos Ayres then sold them to a private individual, but likewise used them, as old Spain had done before, for a penal settlement England claimed her right, and seized them The Englishman who was left in charge of the flag was subsequently murdered A British officer was next sent, unsupported by any power · and when we arrived, we found him in charge of a population, of which rather more than half were runaway rebels and murderers."

"The theatre is worthy of the scenes acted on it An undulating land, with a desolate and dreary aspect, is everywhere covered by a peaty soil and wiry grass, of one monotonous brown colour Here and there a peak or ridge of grey quartz rock breaks through the smooth surface Everyone has heard of the climate of these regions ; it may be compared to that which is experienced at the height of between one and two thousand feet on the mountains of North Wales ; having however less sunshine and less frost, but more wind and rain "

The Fullerian Professorship of Physiology

In 1833 John Fuller, a wealthy and somewhat eccentric member of Parliament and landowner of Rose Hill, near Robertsbridge in Sussex, endowed at the Royal Institution the Fullerian professorship of chemistry which was held by Faraday to the end of his life. Fuller, if the tales about him are to be believed, was distinguished alike for his turbulence in the House of Commons and his somnolence in the lecture theatre of the Royal Institution, but he had an abiding respect for the Institution and the philosophical attainments of its professors. Early in 1834 he expressed to the Managers his wish and intention of founding another professorship. His offer was gratefully accepted, and on March 10, 1834, he executed a deed of endowment creating the Fullerian professorship of physiology. Unlike the chair of chemistry, which in a hundred years has been occupied by only five professors, Faraday, Odling, Gladstone, Dewar and Bragg, that of physiology was to be tenable for a limited period of three years. The first professor was Peter Mark Roget, physician, and secretary of the Royal Society. Roget was the author of that invaluable book of reference, the "Thesaurus of English Words and Phrases", a work which in recent years has extended his fame to the wide and unthought-of circle of those who take their crossword puzzles seriously.

John Fuller, in founding his professorships, added to the benevolent purpose of making some return to society for the benefits he had received during a long life, the patriotic intention of helping to maintain Britain's great and growing reputation in the field of scientific inquiry. His professors have fulfilled his intention. The list of the Fullerian professors of physiology is a much longer one, but it is no less distinguished than that of the professors of chemistry, and includes such names as Huxley, Owen, Michael Foster, Ray Lankester and Sherrington. Only twice in its history has the chair been held for a second period of three years, by Thomas Henry Huxley and, more recently, by Sir Arthur Keith

Great Western Railway

The Great Western Railway may be said to have had its birth at a public meeting held in Bristol on July 30, 1833 Eight months later, on March 10, 1834, in the House of Commons, petitions for and against the line were presented, and the second reading of the bill for the railway was passed by 182 votes to 92. The petitions in support of the line came mainly from the towns such as Bristol, Bath, Stroud and Cheltenham, while those against the line were mainly from the landowners in Berks and Bucks and "certain individuals residing at Earl's Court, Brompton" The Marquis of Chandos, in opposing the bill, said he did so principally on account of the strong feeling that existed among the landed interest of that part of the country he had the honour to represent Not only would the line pass through many private grounds and subject the occupiers to all the inconveniences attending it, but in many cases it would entirely destroy valuable farms and other private property, from the deluge that would be occasioned in the lowlands by the embankments that must be necessarily thrown up on each side of the line Capt Dundas objected to the railway as "it would turn adrift many hundred seamen in the coasting trade , and if the bill was carried, the next railway would be to Shields and Sunderland to carry coals, and then the navy would be ruined, and the breed of seamen soon become extinct"

Foundation of the Statistical Society

"A new Society under this title has arisen from last year's meeting [1833] of the British Association for the Advancement of Science The eminent individuals who formed the committee of the Statistical Section at Cambridge invited a public meeting at the rooms of the Horticultural Society on the 15th of March [1834]. There were about 250 persons present, and the Marquis of Lansdowne took the chair His lordship informed the meeting that the Government would be glad to avail itself of the labours of such institution , which, in return, should have the assistance of Government when it was necessary The Lord Advocate, Mr. Babbage, Mr. Jones, of the London University, Mr. Spring Rice, Mr. Hallam, and Mr. Brunel spoke warmly in favour of the projected institution. The following resolutions were passed unanimously— That accurate knowledge of the actual condition and prospects of Society is an object of great national importance, not to be attained without a careful collection and classification of statistical facts—That a Society be established by the name of the Statistical Society of London ;

and that the Society consist in the first instance of such of the present company as shall subscribe an obligation to that effect—That the Committee be empowered, until the day of the next meeting, to receive the signatures of additional members, and to admit them Fellows of the Society Messrs Babbage, Jones, Hallam, and Drinkwater were nominated a Committee M Quetelet, of Brussels, to whom the formation of this statistical section of the British Association at Cambridge was mainly due, was elected the first honorary member.

"A statistical society was founded three or four years ago in Paris, and similar societies are now forming in other countries This disposition of mankind to associate together for common objects will lead, at no distant period (viz, at the time when representative governments shall have become general), to European, American, and Cosmopolitan Societies, composed of members of all the governments of Europe, America, or the world meeting together to devise plans for the good of all mankind Among these will be, universal education, a universal system of weights, measures, and moneys, one common language, one common law, and universal freedom of commerce As to the question of peace or war, there will be very little danger of the latter, when it is not the interest of any particular class of men to make it" (*Gentleman's Magazine*)

Societies and Academies

LONDON

Royal Society, March 1 A J Bradley and J. W Rodgers The crystal structure of the Heusler alloys In an investigation of the ferromagnetic alloys of copper, manganese and aluminium, an alloy was found which showed an almost complete change of crystal structure due to heat treatment Drillings of this alloy, which had been annealed at 500° for several hours and cooled slowly to room temperature, were found to have the δ copper aluminium (Cu_9Al_4) type of structure The alloy is non-magnetic, but on quenching from 800° C it becomes strongly ferromagnetic The structure is now entirely body-centred cubic, with a face centred superlattice On comparing X-ray powder photographs of the same specimen made with radiations from iron, copper and zinc anticathodes, it was found that the relative intensities of the weaker reflections varied with the wave-length of the radiation This made it possible to distinguish the manganese atoms from the copper atoms C Sykes and H Evans Some peculiarities in the physical properties of iron aluminium alloys An account is given of measurements of the resistivity of alloys of iron and aluminium containing 11–16 per cent aluminium by weight Resistivity at room temperature depends on the rate of cooling of the specimens from a temperature of the order of 600° C. Alloys in this range consist of a single solid solution at all temperatures concerned It is concluded, therefore, that rearrangement of atoms takes place in the alloys under slow cooling conditions, and the more regular arrangement so produced leads to a decrease in resistance Experimental results suggest that the rearrangement of atoms in the space-lattice takes place over a considerable range of temperatures even under conditions of very slow cooling.

DUBLIN

Royal Dublin Society, December 19. J Reilly, P. P. O'Donovan and Miss H. Murphy · A note on the molecular complexity of amylose in potato starch. Cryoscopic determinations of the molecular weight of dry amylose dissolved in acetamide gave consistent values corresponding to the formula $(C_6H_{10}O_5)_2$. Desiccation experiments showed that drying at 78° C. under 10 mm pressure completely removed all water and alcohol from the amylose, so that the relative simplicity of the molecules in acetamide solution could not be attributed to the formation of polysaccharide water or alcohol complexes On the other hand, the ash-content of the amylose could not be reduced much below 0 9 per cent, and it is suggested that the presence of this small quantity of ash may possibly be of importance in the depolymerisation of the amylose. Joseph Doyle and Mary O'Leary Abnormal cones of *Fitzroya* and their bearing on the nature of the conifer strobilus The structure of abnormal staminate and hermaphrodite cones of *Fitzroya* is described. On the basis of these structures it is tentatively suggested that —(*a*) the stamen and the bract of the ovulate cone are homologous. (*b*) There is no auxiliary structure, particularly no reduced branch, in the organisation of the ovulate cone, the ovules being directly related to the bract (*c*) Neither bract nor stamen is a sporophyll in the sense of a structure in any way similar to a vegetative leaf carrying sporangia (*d*) Both bract and stamen are the end development of an extreme reduction of a primitive *reproductive branching system carrying sporangia*, probably terminally, on the ramifications, the main plan of the cone being attained before, or at least independently of, the photosynthetic development *which gave rise to the leaf.*

PARIS

Academy of Sciences, January 15 (*C R*, 198, 213–292) The president announced the death of Paul Villard, member of the Section of Physics, Paul Vieille, member of the Section of Mechanics and Jean Cantacuzène, *Correspondant* for the Section of Medicine and Surgery Hadamard Observation on a recent note by M Adamoff E Jouguet Indifferent points and critical points Ch Achard and Léon Binet The effects of sodium thiosulphate on poisoning by potassium cyanide From experiments with fish it has been shown that sodium thiosulphate exerts a curative action in poisoning by potassium cyanide J Favard A surface with given boundary Paul Alexandroff The local properties of closed ensembles Mandelbrojt · Fourier's series with gaps. F Leja A method of construction of Green's function belonging to any plane domain. A. Rauch. The bands of divergence of certain functions of infinite order Nikola Obrechkoff The real zeros of polynomials. L. Pontrjagin Compact topological groups and the fifth problem of Hilbert V A Kostitzin: An integro differential equation of elasticity. A. Magnan and H Girerd · The determination in a wind chamber of the polars of butterflies Armen Astazadour · The lines of current round a plate in rotation, placed in a fluid current. E. Carvallo: The velocity of the earth measured by purely terrestrial measurements. Calculations based on the experimental data of Esclangon. Bernard Lyot. The polarisation of the solar protuberances. An account of work carried out at the Meudon Observatory. Of the fourteen protuberances studied, all except one show distinct polarisation. J. P. Mathieu: A class of tartaric compounds. Discussion of the composition of the tartrates of chromium, manganese, iron, nickel, cobalt and zinc. Mme. Irène Curie and F. Joliot: A new type of radioactivity. A description of a new phenomenon. The emission of positive electrons by certain light elements (beryllium, boron, aluminium) when irradiated by the α-rays of polonium continues for some time after removing the source of the α-rays and in the case of boron this time may be as much as half an hour. The intensity of the radiation decreases exponentially with time and the periods differ for each element. These experiments prove the existence of a new type of radioactivity with emission of positive electrons (see also NATURE, Feb. 10, p. 201). Mme. P. Rumpf: The kinetic study of the reaction between potassium iodide and hydrogen peroxide in acid solution. The rate of formation of the I_3 ion has been studied with the spectrograph. Mlle. Suzanne Veil: The action of the electric field on the stratified diffusion of the alkaline carbonates in gelatine. Joseph Zawadzki and Georges Perlinski: The decomposition of nitric oxide by platinum catalysts. The reaction is monomolecular and strongly retarded by oxygen. René Dubrisay and Guy Emschwiller: The oxidation of iodoform solutions. A study of the effect of impurities in the solvent. H. Herissey: Lusitanicoside. Mme. Ramart Lucas: The colour and structure of the aromatic oximes. P. Rumpf: An electrochemical contribution to the problem of the constitution of the salts of triarylmethyl. G. Carpenisfanu: The determination of pyruvic acid. A modification of the method of Simon and Piaux. P. Carré and D. Libermann: The influence of the phenyl group on the reaction of thionyl chloride with primary fatty alcohols. R. Delaby, S. Sabetay and M. Janot: The characterisation of double bonds by antimony trichloride. Lamare: The Permian in the neighbourhood of Bidarray (Basses-Pyrenees). Paul Bouvier: A meteor observed in Morocco. N. Théobald: The fossil insects of Célas (Gard). G. A. Nadson and C. A. Stern: New observations on the biological action of metals at a distance. R. Bonnet: The neuro-muscular action of the amides and ammoniacal salts. Mladen Paić: The absorption spectra in the ultra-violet of sera from syphilitic subjects. S. Nicolau, Mme. L. Kopciowska and M. Mathis: Intranuclear inclusions in the nervous system of guinea pigs and of mice dead from experimental yellow fever. Genesis, morphology and interpretation.

ROME

Royal National Academy of the Lincei: Communications received during the vacation. E. Almansi: Deformations of elastic strips (9). In this final note, various further questions of purely analytical character are considered. T. Viola: Baire's functions of the first and second classes. If $y=f(x)$ and $x=\varphi(t)$ are two functions of Baire's first class, the compound function $y=F(t)=f(\varphi(t))$ is, at the most, of the second class. The conditions under which it can be affirmed that this compound function is of the first class are now discussed. A. Terracini: Congruences associated with respect to a surface. C. Bertolini: Study of an equation to the partial derivatives of the third order. R. Caccioppoli: Non-linear elliptic equations to partial derivatives. B. de Finetti: Classes of equivalent aleatory numbers. Maria Cibrario: Bernoulli's and Euler's numbers. C. Agostinelli: Geodetic curvature of dynamic trajectories. Z. Pycha: Radius for waves associated with phenomena. V. Kupradze: Diffraction of elastic waves on an elliptic contour. G. Racah: Number of isotropic and hemi-isotropic tensors in spaces of several dimensions. The results previously obtained in determining the number of isotropic tensors of a Euclidean S_3 are extended to Euclidean spaces of several dimensions, true isotropic tensors being separated from hemi-isotropic tensors. D. Palermo: Surface dilatations of elastic solids. G. B. Bonino and G. Centola: Investigations on the theory of concentrated solutions of strong electrolytes; possibility of extension to the calculation of osmotic coefficients. The theoretical considerations used previously for calculating the activity coefficients of strong electrolytes are now applied to calculation of the osmotic coefficients of such solutions. Good agreement with experimental data is shown. F. Garelli and G. Racciu: Ethylacetanilide as a cryoscopic solvent, and the molecular weights of certain cellulose esters dissolved therein. This solvent crystallises better than triphenyl phosphate and freezing points of its solutions are easier to read. For its molecular freezing point depression the mean experimental value is 85·8 and the calculated value 87. At low concentrations, nitro-, acetyl- and ethylcelluloses form true solutions in ethylacetanilide, their molecular weights corresponding with the dimeric formulæ $(C_6 \times 2)$. A. Rossi and A. Iandelli: Crystalline structure of the compound MgPr. This compound forms monometric crystals of density 4·67. The unit cell, of side 3·88 A., contains one molecule. G. Mezzadroli and A. Amati: Action of certain alkaloids on the metabolism of glucides by *Aspergillus niger*. The consumption of glucose or sucrose by this mould in Wehmer's or Raulin's solution is increased by the presence of 0·05–0·3 per cent of strychnine or quinine, but caffeine has the opposite effect. R. Novello: Observations on the activity of chloroplasts in a southern climate. Of 114 plants studied, 91 showed amyliferous chloroplasts, lipids also being present in 55 cases. Chloroplasts with only lipid inclusions were found in 19 plants, whilst with 4 of the plants neither starch nor lipids occurred in the chloroplasts. Lipids included in the cytoplasm were observed in a number of instances. R. Savelli: Heleochloroplasts. This name is given to a peculiar form of assimilatory plastid, characterised mainly by carrying a large parastromatic vesicle, and found in various plants. S. Genussa: Integration by quadrature of the equation $\partial^2 z/\partial x^2 - a\,\partial^2 z/\partial y^2 = f(x, y)$.

SYDNEY

Royal Society of New South Wales, November 1. E. C. Andrews: Origin of modern mountain ranges. Modern mountain systems comprise cordillera and ordinary plateaux. Both are earth undulations—broad and swelling as plateaux in the more stable earth structures, but crowded together to form cordillera in relatively unstable earth zones, with resultant subparallelism and syntaxis of ranges (with appropriate development of intermontane valleys). They are arranged marginally, in the main, to continents or great continental nuclei; their growth has been saltatory (punctuated with pauses of still-stand), yet so slow that large streams have maintained their ancient courses against the uplift; earth movements have determined the formation of the ranges, while isostasy, through rock flowage, has determined their form, namely, as undulations balancing each other in positions of variable unstable equilibrium. Earthquakes and volcanoes are incidental features. The cordillera and the main continental plateaux are physiographic unities, all being dependent upon a deep underlying and world-wide control operating in late and post-Tertiary time. A R. Penfold and F. R. Morrison: The essential oils of *Eucalyptus micrantha*, including a form rich in piperitone The essential oil of *Eucalyptus micrantha* (type) is of no economic value, but that obtained from the new variety, var. *A*, is of potential value since it contains 40–50 per cent piperitone M B Welch: Equilibrium moisture content of seasoned timber Whilst it was found that a number of timbers indoors in Sydney only showed a mean variation of about 2·0 per cent moisture, at Broken Hill and Hay the variation was nearly 8 0 per cent, and whilst individual timbers in country districts during summer contained less than 5 per cent, in winter the figure reached was nearly 19 0 per cent moisture Of a number of timbers used, Queensland maple showed the greatest fluctuation in moisture content

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Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, March 12

Victoria Institute, at 4 30—Dr W M Christie "The Jewish Immigrant Population of Palestine".

Royal Geographical Society, at 5—J A. Steers "Scolt Head Island".

Tuesday, March 13

Institution of Petroleum Technologists, at 5 30—Annual General Meeting.

Pharmaceutical Society, at 8 30—C. E Carfield: "The British Pharmaceutical Codex—Some Notes on its Revision" *

Royal Society for the Protection of Birds, at 3—(at Church House, Westminster, S W 1)—Annual Meeting

Wednesday, March 14

Geological Society, at 5 30—Dr L Hawkes "Some Javanese Volcanoes, with notes on the Tectonics of the Island Arcs of the East Indies"

Television Society, at 7—Sixth Annual General Meeting

Sir Ambrose Fleming "Invention in Relation to National Prosperity and Legislative Control" (Presidential Address).

Thursday, March 15

Institution of Electrical Engineers, at 6—C C. Paterson "The Electrical Engineer and the Free Electron" (Faraday Lecture).

Friday, March 16

Association of Applied Biologists, at 11 45—(at the Imperial College of Science and Technology, South Kensington, S W.7).

At 11 45, Dr W Maldwyn Davies: "The Sheep Blowfly Problem"

At 2 30, Dr. I. Thomas. "Some lesser-known Pests of Cereals with Observations on the Source of Infestation".

J. C. F. Fryer. "The Colorado Beetle".*

Official Publications Received

GREAT BRITAIN AND IRELAND

International Agreement, Brussels, 1924 Venereal Diseases: Centres in the Ports at Home and Abroad where Seamen can obtain Treatment (List 7a, revised) Pp 23 (London Ministry of Health.)

Liverpool Observatory and Tidal Institute Annual Report, 1933 Pp 16 (Liverpool Observatory and Tidal Institute)

The Scientific Proceedings of the Royal Dublin Society Vol 21 (N S), No 4 A Note on the Molecular Complexity of Amylose in Potato Starch By Dr J Reilly and Miss H Murphy Pp 37–42. (Dublin Hodges, Figgis and Co, London Williams and Norgate, Ltd) 6d

A List of the more Important Collections in the University Herbarium, Cambridge By J S L Gilmour and T G Tutin Pp 40 (Cambridge Botany School) 2s 6d

Navy (Health) Statistical Report of the Health of the Navy for the Year 1932 Pp 144 (London H M Stationery Office) 2s 6d. net

Imperial Bureau of Plant Genetics Herbage Plants Bulletin No 14 Grassland Research in Australia, Future Programme and Contributions on Pasture Technique Pp vi+43 (Aberystwyth Imperial Bureau of Plant Genetics) 3s

The Carnegie Trust for the Universities of Scotland Thirty-second Annual Report (for the Year 1932–33), submitted by the Executive Committee to the Trustees on 7th February, 1934 Pp iv+202. (Edinburgh Carnegie Trust for the Universities of Scotland)

The National Institute of Poultry Husbandry (Harper Adams Agricultural College), Newport, Shropshire Bulletin No 9 A Progress Report of Instructional and Experimental Work Pp 64. (Newport)

Department of Scientific and Industrial Research The Investigation of Atmospheric Pollution Report on Observations in the Year ended 31st March 1933 (Nineteenth Report.) Pp vii+99 (London: H M Stationery Office) 5s net.

OTHER COUNTRIES

U S Department of the Interior Office of Education Bulletin, 1933, No 8 A Background Study of Negro College Students By Ambrose Caliver Pp vii+132 10 cents Bulletin, 1933, No 13 High-School Instruction by Mail, a Potential Economy By Walter H Gaumnitz Pp v+69 10 cents Bulletin, 1933, No 14 The Effects of the Economic Depression on Education in other Countries By James F Abel Pp v+37 5 cents Leaflet No 44 The Deepening Crisis in Education Pp 16 5 cents (Washington, D C Government Printing Office)

U S Department of Agriculture Technical Bulletin No 373 Studies of Fluorine Compounds for Controlling the Codling Moth By E J Newcomer and R H Carter Pp 24 (Washington, D C, Government Printing Office) 5 cents

U S Department of the Interior Geological Survey Bulletin 846–A Some Mining Districts of Eastern Oregon By James Gilluly, J C Reed and C F Park, Jr (Contributions to Economic Geology, 1933, Part 1) Pp viii+140+8 plates 25 cents Bulletin 846–B Geology and Ore Deposits of the Takilma–Waldo District, Oregon, including the Blue Creek District By Philip J Shenon (Contributions to Economic Geology, 1933, Part 1) Pp v+141–194+plates 9–22 20 cents Bulletin 849–B Lode Deposits of the Fairbanks District, Alaska By James M. Hill (Investigations in Alaska Railroad Belt, 1931) Pp x+29–163+plates 3–10 35 cents Bulletin 849–C The Willow Creek Gold Lode District, Alaska. By James C. Ray (Investigations in Alaska Railroad Belt, 1931) Pp viii+165–229+plates 11–20 20 cents (Washington, D C Government Printing Office)

University Observatory, Oslo Publication No 9 On the Interpretation of the Umkehr-Effect in Atmospheric Ozone Measurement By Chaim L Pekeris Pp 31 Publication No 10 On the Trajectories of Electric Particles in the Field of a Magnetic Dipole with Applications to the Theory of Cosmic Radiation, First Communication By Carl Størmer Pp 19+9 plates (Oslo Jacob Dybwad)

Colony and Protectorate of Nigeria Report on the Agricultural Department for the Year 1932 Pp ii+47 (Lagos Government Printer) 4s net

U S Department of Agriculture Technical Bulletin No 399 A Study of Claypan Soils By Irvin C Brown, T D Rice and Horace G Byers Pp 43 (Washington, D C Government Printing Office.) 5 cents

Publications of the Observatory of the University of Michigan Vol 5, No 10 A New Method of Driving Equatorial Telescopes. By Robert R McMath and Walter A Greig Pp 123–131+2 plates. Vol 5, No 11 The Elements and Ephemeris of Comet 1933f (Whipple). By Allan D Maxwell and Helen M Porter Pp 133–135 (Ann Arbor, Mich)

Library of Congress Report of the Librarian of Congress for the Fiscal Year ending June 30, 1933 Pp vi+264+20 plates (Washington, D C Government Printing Office) 75 cents

U S Department of Agriculture Circular No 295 The Obscure Scale on the Pecan and its Control By Howard Baker Pp 20 5 cents Miscellaneous Publication No 174 The Serphoid and Chalcidoid Parasites of the Hessian Fly By A B Gahan Pp 148 10 cents (Washington, D C Government Printing Office)

South Australia. Annual Report of the Director of Mines and Government Geologist for 1932 Pp 8 (Adelaide Government Printer)

Natal's Nature Sanctuaries in Zululand. By E K du Plessis. Pp. ii+23 (Pietermaritzburg. The *Natal Witness*, Ltd)

CATALOGUES

Catalogue de livres anciens et modernes rares ou curieux relatifs à l'Orient (No 26) Pp 307–402. Catalogue des publications suivi d'une liste de grammaires et dictionnaires les plus usités Pp 16. (Paris Librairie Adrien-Maisonneuve)

B D H Injections for Parenteral Medication. Pp. 54 (London: The British Drug Houses, Ltd)

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The Devolution of Government

POLITICAL events of the last year have scarcely encouraged scientific workers who are dubious about the capacity of our present structure of society to meet our economic, industrial or political needs without profound modification to look hopefully towards the corporate State as exemplified by Italy or Germany Not even Dr Levinstein's recent eulogy of nationalised industry is likely to tempt them to support policies so threatening to the stream of independent thought upon which progress in science, as in every other sphere, ultimately depends Nor is the alternative to Fascism as represented in Soviet Russia, for all the encouragement given to scientific research and to scientific methods, likely to turn them *en masse* to the support of the more extreme socialistic or communistic ideals

Scientific workers therefore who think less pessimistically than Mr G D H Cole, Prof H J Laski and others about the capacity of our existing system to modify and reform itself in accordance with the changed needs and demands, will be inclined therefore to give a sympathetic hearing to Capt Harold Macmillan's recent plea* for a national policy which is an alternative to either Fascism or Communism In his recent book he describes in greater detail suggestions previously made in his pamphlets "The State and Industry in 1932" and "The Next Step" which have already been noted in NATURE

The scientific worker should not be altogether unprepared for the proposals now outlined They have to some extent been foreshadowed by General Smuts in his lecture on "Science and Democracy", and represent essentially an attempt to find within our existing political constitution a means by which the expert advice and criticism may be brought effectively to play on the mechanism of Government It is an attempt to substitute knowledge for prejudice in the affairs of industry and State, without recourse to the autocracy which violent change either towards the left or the right is so liable to provoke, and displays an example of hard thinking which must be much more widely practised if we are to emerge from our difficulties and the recent slight improvement is not to prove a prelude to worst disasters

Capt. Macmillan unhesitatingly attributes the failure of the World Economic Conference to its failure to grapple with the underlying causes rather than with their effects. Agreement on tariffs, exchange restrictions, uneconomic prices, currency fluctuations, etc, could not be secured because of the deeper conflicts arising from economic nationalism and disproportion or disequilibrium in production. The problems of growth and change to which our social, political and economic organisation must be adjusted were not really faced, and solutions to them must be sought in a spirit of world co-operation as well as of world re-habilitation

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* Reconstruction: a Plea for a National Policy By Harold Macmillan Pp xi+141 (London. Macmillan and Co, Ltd, 1933) 8s 6d net.

It is important to note the spirit in which Capt. Macmillan has conceived his proposals for reconstruction. As just indicated, in contrast to many other schemes, the policy he outlines seeks to improve our position without inflicting injury on our neighbours Too often economic policy is advocated or executed with an entire disregard of the injury it inflicts on other countries and the subsequent repercussions in our own trade This indeed is one of the strongest points in the plea for definite planning of industry, if only to ensure that action beneficial at first sight to one industry is not detrimental to industry or the nation as a whole or in the long run to that industry itself

The fundamental principle of planning should be beyond question at the present time The real issue is whether economic planning—the regulation of production in accordance with effective demand —is possible on a national scale as it is within definite limits with every successful individual producer, without incurring the dangers associated with such words as 'monopoly'. Capt Macmillan sees that, for adequate protection, regulative powers amounting to monopoly must be granted to efficiently organised and integrated national industries, but he is not intimidated by the word and considers that adequate safeguards are possible.

The essential principle of the plan advocated is the direction of production by a central authority for each industry through the grant of monopoly powers in return for the acceptance of certain social responsibilities. National industrial councils would be created for each industry or group of industries, the function of which would be to encourage and assist the efficient co-ordination of purchasing, production and research. Industry would thus become organised as a number of self-governing units enjoying sufficient authority to prevent a recalcitrant minority delaying progress or the continued erection of redundant plant by new producers where plant is already idle, of which conditions in the canning industry provide an unhappy example

Without some such self-governing authority it will continue to be difficult to prevent an industry from being robbed of the fruits of wise leadership, scientific management or co-operation through the disturbing influence of new producers Co-ordination of the policies of different industries would be secured through a Central Economic Council or Investment and Development Board, representing Government and finance as well as industry This Central Council, under the chairmanship of a Cabinet minister, would be a kind of industrial parliament, its duty being to advise the Imperial Parliament and carry out agreed industrial policies Since its function would be that of giving expert advice and the execution of Parliamentary decisions, there is no danger in the Central Council becoming a rival to Parliamentary government, indeed, owing to the Council's knowledge of the facts Parliament should be able to devolve on the Council tasks and functions which it could not itself perform

It is a bold claim that such a scheme, headed by a Central Economic Council on which trade unions are also represented, would provide a counterpart in the economic sphere to the political extension of the franchise It is not, however, lightly to be dismissed The scheme is a courageous attempt to relate more effectively knowledge and action, the hiatus between which has been responsible for so many of our ills Everything turns on the way in which the new powers conferred by the scheme are used. If they are used to determine action in accordance with the full facts, and not in accordance with half the facts or supposed facts, the machinery might well be worth a trial

The stress laid on social responsibility is accordingly vital The scheme must be worked in the spirit in which it has been conceived, and it is just the anti-social and incredibly narrow attitude of certain employers' associations to the unemployment question, and to proposals to alleviate that situation, which creates the most serious misgivings about the scheme. A like attitude, a similar refusal to recognise inconvenient facts and selfish disregard of the other side would wreck the whole scheme within a few months of its being launched. Given, however, a generous spirit, a wide vision of service and minds which set themselves unhesitatingly on the full facts, it might give us all that Capt. Macmillan claims. In any event it challenges scientific workers in all their contact with industry to promote such a spirit and atmosphere in which alone true reconstruction is possible. From their ranks must be drawn some at least of the leaders whose temper and knowledge can best serve the present occasions Already it seems almost certain that the solution of our problems depends on the evolution of new machinery of government, in which the individual and collective conceptions of society each find a harmonious place as well as permit the right relation of knowledge and power The violence which both conceptions alone have done to liberty and thought in recent years do not inspire confidence in their ability to lead mankind to higher levels, and science at least might be disposed to search for the truth in some such compromise as that conceived by Capt Macmillan

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University Progress

History of the University of Edinburgh, 1883-1933 Edited on behalf of the History Committee by Dr A Logan Turner Pp xxxi + 452 + 26 plates (Edinburgh and London Oliver and Boyd, 1933) 10s net

THIS volume gives the record of fifty years of work in an old university—the youngest, and yet in some respects the greatest, of the Scottish universities Its most intimate appeal must therefore be to the multitude of the teachers and alumni who have passed and repassed the great gateways during the seventh of the inter-jubilee periods. Yet in that period wide problems of university finance and procedure and progress have arisen and been solved, or have been launched on the way to solution Questions of interest, or even of gravity, regarding the wisdom or unwisdom of steps taken, push themselves into consideration ; and, with institutions as with individuals, it is the sign of the sum total which matters On the credit side at least the total is never fully known,

"But, all the world's coarse thumb
And finger failed to plumb,
So passed in making up the main account,
All instincts immature,
All purposes unsure,
That weighed not as the work, yet swelled the whole amount,"

were of positive value though they can have no visible place in this volume.

The University of Edinburgh differs from all the other Scottish universities in that it originated outside Church influence , it was 'The Toun's College' And right well, on the whole, did the city fathers guard and nourish its infancy and youth until, in the progress of the centuries—about the middle of the last jubilee period—it stepped forth on its own path Yet there was no complete severing of the old influence, as there could be no complete parting from the old home 'Town and Gown' still go hand in hand, and the voice of the city is heard in the councils of the University Through access to records, the present volume of the history extends, in a most interesting way, knowledge regarding the earliest stages of the development of the old College, beyond the information available fifty years ago when the first volume was issued.

Not in early days alone did poverty sit on the University benches—peer's son and ploughman's son together not then alone did city fathers struggle for the common good, while fathers and mothers in the cottages went stintedly so that the lad o' pairts might enter upon his life's struggle with the hall-mark of a university upon him Even to this day in Scotland (as elsewhere) there are university students who labour during long hours that they may learn in some of the rest These conditions have been eased largely during the fifty years by the generosity of benefactors—detailed in this volume—notably through the funds administered by the Carnegie Trust Yet this easement may be found to be not without its price There are many who think that the loss of the brave old spirit of independence would be too great a price to pay , and that is not least the thought of the dauntless few of the needful ones who will nevertheless accept no aid The funds of the Trust are in part supplied to students on the understanding that repayment in the future will be acceptable ; but conditions do not in general work out so in practice Another view is that the number of students who are thus encouraged to seek a university training unavoidably includes many who are not specially fitted to benefit thereby, and who would be more usefully trained in other ways At present the whole problem is made very complicated by the adverse world conditions

Another fear regarding trust-administered funds, when these are great, is that the trust tends to become a dictator This condition applies even to Government administration, although there is some safeguard in that case through Parliament In smaller matters also, donors who have become wealthy through their own efforts have a tendency to lay down restrictions having an import which lies beyond their own horizon Well back in the fifty years, Lord Rosebery warned the Scottish universities against the surrender of their autonomy. The compulsion of surrender is apt to arise insidiously, and perhaps even unpremeditatedly, so that all decisions regarding matters of national importance should be, even in their initiation, open to control All allocations of important funds should, with the reasons annexed, be open to scrutiny Yet it seems to be possible, at least theoretically, for a body such as the Carnegie Trust to come to decisions which might adversely affect individual universities A great example is given by the Treasury itself, which regards the universities as being themselves the best judges of the right mode of spending the grants of money which it makes to them The same wise course has been followed by several of the donors of munificent gifts which are recorded in this volume

The Scottish universities are tied together by the condition that a desired ordinance cannot be issued for one until it has passed the scrutiny of the rest Formerly the tie was more rigid and lay as a blight upon the possibility of individual advance A main purpose of the tie in its present form is to make impossible a step by one which might act detrimentally on the interests of another —a quite laudable object But a recent proposal that the University of Edinburgh should be empowered to grant an honours degree in pure science seems to have been opposed successfully by the University of Aberdeen on the grounds that the proposed degree was not of much higher standard than the present pass degree, that students who might not be capable of attaining a high standard of honours in the other honours science degrees would tend to compete for this relatively weaker degree, and that the proposal emanated from the schools Now it may not be impossible for the standard of the proposed degree to be higher than a low standard of honours in the present more special honours science degrees, and the institution of the new degree might quite conceivably make possible the abolishment of the present third class grade of honours in science, and so raise appreciably the standard of that more special degree. Near the beginning of the present jubilee period in Edinburgh, Chrystal grudgingly admitted the desirability of a third class grade in honours, and he did so in view of a need for an honours degree, for school teachers, which did not exact too high a standard of specialisation. If the schools recognise that the level of attainments of school teachers in general science should be greater than the level required for actual teaching, and if the proposal for such a degree came from the schools, so much the greater is the credit to them, and so much the greater is the likelihood of its wisdom But, at any rate for the time, Aberdeen has debarred the suggestion of Edinburgh

These are problems of a type which any university may have to face in its work for the nation, and there are other wider problems of policy of which the record in this volume gives examples One of the most important, which arose before the beginning of the half century and was solved in its early years, was that of the admission of women students In this matter the University of Edinburgh was a pioneer—the inevitable outcome of its pioneering work, in still earlier days, through the medium of extra mural classes for women, taught by members of the University staff Undoubted success has attended the step The number of students aiming at an arts degree has in consequence greatly increased, so that, in point of numbers, the Arts Faculty has now ousted the Medical Faculty from first place, and has become almost as much a Faculty for professional training The Divinity Faculty alone, although it has opened its classes to women students, has resisted the *Zeit-Geist* so far in debarring them from its profession The professional aspect of the problem accounts also for the great development of the young Faculty of Science within the fifty year period

Another interesting and successful development in these years is the partial return to the early residential condition obtaining in the Toun's College, through replacement of 'lodgings' by 'hostels' If it gives less complete conditions for study, it has other great advantages

The teaching staff has increased nearly sixfold in the fifty years, and the increase of departments and buildings has been on an explosive scale also—so much so that some critics doubt if it should not be regarded as a gamble rather than as an example of wise forethought But if, one hundred years ago, wisdom had foreseen the present compulsion to expansion, the huge sums recently expended on the acquirement of sites would have been immensely lessened and the scattering of university fragments over the face of the city would have been avoided But there was also want of prevision of the petrol motor which has made that scattering comparatively unimportant Since all knowledge is based upon faith, the exhibition of faith in the headquarters of knowledge is appropriate

Another, and one of the greatest, of the steps taken was the recognition of the body of students as a corporate part of the University, having a Representative Council established for the purpose of guarding the interests of the students, and empowered to express their views to the higher authorities The wisdom and influence of this step became at once apparent , and it was followed by the other Scottish universities, by English universities, and even by some on the Continent

Many other features of advance are recorded in the volume, and would repay study The social work of the University of Edinburgh Settlement, shared in by students, is notable , and especially so in its originative share in the general advancement of its work through extension to the work of the newly instituted Kirk o' Field College, where unemployed men receive, at their own request, education rather than entertainment, greatly though they appreciate the latter There, as the donor of the College building said, "The enthusiastic and generous minded student supporters of the Settlement had seen a great opportunity, a unique chance of turning apparent misfortune into co-operative effort, to further education, to revive the joy and pride of craftsmanship, and to weld the classes of the people in community of interest and ideal" , and, as the Chancellor said regarding these unemployed men, "How Scottish it was of them to do that, and how proud we ought all to be to remember that those men are Scottish ; they really are our brothers. They are going to get what they want—more lectures, more instruction All hail to them " They are worthy successors of the students of the earlier days

Though this volume contains records of deep interest to all who study the problems of education, general or scientific, it is in the hearts of many of the world-scattered army of nineteen thousand graduates that there will be raised by it vivid recollections of two powerful impressions made upon them in the days of their youth · one upon the day when first, with awed feeling, they passed beneath the lofty arches of the great gateway which seemed to them then to be the portal of the Temple of Destiny , the other on the day when the Alma Mater—Madam Edinburgh University, as the Chancellor called her—passed them out through the same gateway with the hall-mark of her approval upon them, and they knew it to be the gateway of the Temple of Life

"Never for her to reach the full meridian , and yet, see, watch how she makes around her an atmosphere of light Her eyes—her improbable eyes that you and I shall never fathom—they are fixed not on those 350 years, but on the next 350 that are now beginning She knows very well that the rack of the tough world must still be her portion But she is undismayed, stands full target for all the winds of the future She says 'For a University there can be no harbour' " So said Barrie, her Chancellor, and one of the great amongst her sons

Good wishes go with her as she "beats out to sea"

Mind and Brain

The Brain and its Mechanism By Sir Charles Sherrington The Rede Lecture delivered before the University of Cambridge, 5 December 1933 Pp 36 (Cambridge At the University Press, 1933) 1*s* 6*d* net

SIR CHARLES SHERRINGTON'S Rede lecture delivered at Cambridge last December, and now published, is an amazing compendium of conclusions covering the whole range of scientific inquiry in that field of Nature which has excited man's intensest curiosity

Primarily a manager of muscle, nerve and brain are but a skilfully laid train of powder between the muscles it fires and the restless world outside which fires it Some motor acts, essential but scarcely significant, as behaviour, are driven by nerve action generated within the brain itself The dominant partner in the driving of the brain is the outside world, wherein a limited set of agents working through nerve and brain can produce a thousand and one dexterous acts

The motor instrument is separable into a great number of small units usable individually and in many different combinations Each unit has a single nerve thread, which springs from a wide nerve net In the nerve nets occur at nodal points two kinds of nerve action, one which fires the nerve thread, the other which impedes or prevents this firing Conjointly, these two kinds of action neutralise each other quantitatively Given a large brain net, the animal's behaviour excels in variety and nicety, but is not radically different from the behaviour of reflex action.

Life's aim is an act not a thought, albeit to refrain is no less an act than other actions Inhibition is coequally with excitation a nervous activity One of the processes operative within the mechanism is a travelling signal, a brief local depolarisation of the electrically polarised surface layer of the nerve thread, involving a temporary electrical leak By repolarisation in the wake of the signal, the transmitting surface is repaired This activity involves work. The signals can be made to occur more frequently by intensification but cannot be made bigger In some parts of the brain the repolarisation process is rhythmic, and from such parts trains of signals start periodically

The nerve nets are patterned networks Junctional points provide that signals may converge and coalesce, reinforcing each other's power of excitation The opposite process, inhibition, does not travel but is evoked by travelling signals The nerve nets are, so to say, weighted with inhibition or with excitation This weighting leads to variation, even reversal of response

The brain initiates more than its fair share of acts and exerts censorship "A shell of its immediate future surrounds the animal's head" A vast expansion of the brain has arisen here where the signals from a distance combine Reflex action is enlarged and behaviour amplified The new membrane is so educable as to be practically a new thing in the world Each motor act becomes the servant of more masters, and an observer may judge that the reflex principle is departed from May it be that in those parts of the brain which may be called mental, nerve actions exist still unknown to us, and that these may correlate with mind? "There is, so far as I know, in the chemical, physical properties, or microscopical structure no hint of any *fundamental* difference between non-mental and mental regions of the brain" Nerve inhibition must be a large factor in the working of the mind, but the events we have to correlate with the mental events are not themselves of the reflex type they are back-watered signallings the circuits of which may long be self-maintained. Indeed we have no scientific right to conjoin mental experience with physiological events, but only the right of what "Keats with that Shakespearian gift of his, dubbed 'busy common sense'."

With the attainment of the objective of this exploration, Sir Charles Sherrington predicts that man will certainly try to improve the brain, "restraining some parts, amplifying others, introducing short-cuts, and certainly increasing speed and aiming at economy and devising as seems to him best We need not be prophets to foresee that then will come the long-told speedy extinction of man" This inference surely arises from data undisclosed?

Timbers of Commerce

A Manual of the Timbers of the World their Characteristics and Uses By Alexander L Howard Revised edition, to which is appended an Index of Vernacular Names Pp xxiii+672. (London Macmillan and Co, Ltd, 1934) 36*s* net

EVER since the publication of the first edition of this book in 1920, it has been widely used by timber importers and users of timber, and is looked upon as the standard work on the subject However, many kinds of timbers, some of which are now in use or in the experimental stage—particularly kinds of Empire origin—were omitted from the first edition, and Mr Howard has taken the opportunity of describing a large number of extra kinds in his new work An idea of the many additions may be gained from the two hundred or more pages that have been added to the present edition, all of which are devoted to descriptions. Moreover, the whole of the pages describing the artificial seasoning of timber in the earlier work have been used for timber descriptions in the new volume

Not all the timbers mentioned are used in the British Isles, nor are some of them likely to be used in the future, but they have come under the author's notice and he has included them in his descriptions In some instances timbers are only known to the author by their vernacular names; whether it was wise to include them without an effort to trace their botanical origin is very doubtful, but as Mr Howard is one of the leading timber importers in Great Britain, he doubtless has very good reasons for their inclusion, and with his very wide and varied knowledge of the uses and manufacture of timber, the correctness of the commercial side of the book should be beyond dispute.

An alphabetical arrangement of subjects is given, but it is open to criticism, for there is an indiscriminate mixing of common and botanical names which often results in some species of a genus being described with the common name most prominently placed, and in others the generic name being given the place of honour. The following examples are illustrations —

Alder,	*Alnus glutinosa*, Gaert.
Alder, Formosan	*Alnus maritima*, Nutt var *formosana*, Burkill [*A formosana*, Makino].
Alder, Red	*Alnus oregona*, Nutt
Alder, White	*Alnus rhombifolia*, Nutt

Five other subjects are then described and are followed by *Alnus nepalensis*, Don

On pages 145–146 three species of *Dalbergia* are described with the generic name first On pages 457–458 other species of *Dalbergia* are described under rosewood, and on page 487, *Dalbergia sissoo* is described under sissoo Many such examples occur There are certainly very good indexes to both common and botanical names, but in a work of this description, where botanical names are in constant use, it would have been a better arrangement and have given a much better impression had the author kept to a proper alphabetical arrangement of botanical names There are greater difficulties in following out a strict alphabetical arrangement of common names, for some timbers are equally well known in commerce under several epithets and many cross references would have been necessary

It is also regrettable that the author did not get someone well versed in botanical nomenclature to go through his manuscript, for there are numerous slips, one of which occurs on page 43 A timber is described as Avodire, and the botanical name is given as *Africana Bingeria* The name the author had in mind was really *Bingeria africana*, A Chev, which is actually a synonym of *Turræanthus africana* (Welw), Pellegrin

The misuse of capital letters in specific names is noticeable, and a good deal can be said for the decapitalisation of all specific names in books such as the one under review, a course that would certainly be less confusing for the author

Apart from these little defects the book has a great deal to commend it, for it is teeming with useful and interesting information, is well printed and well illustrated It should find a place amongst the most used books of timber merchants and manufacturers of timber W D

Short Reviews

Industrial Chemistry. By William Thornton Read Pp vii+576 (New York · John Wiley and Sons, Inc ; London · Chapman and Hall, Ltd, 1933) 31*s* net

THE four opening chapters of this volume deal with such matters as chemical organisations and literature, and the various functions of the chemist in industry. They might very well have been condensed considerably and, in parts at any rate, omitted, since they bring the author dangerously near that category of zealous exponents of the obvious which, according to his statement on p. 31, he desires to avoid. There is, however, much to be learned from the succeeding chapters on chemical economics, equipment and constructional material in spite of their pronounced American bias.

The remainder of the book is a series of brief but useful monographs on various applications of chemistry to industry, for example, the sulphuric acid, nitrogen, fertiliser, metallurgical, petroleum, electrochemical, rubber, coal, paint and explosives industries; foods, textiles and fermentation are omitted, although there are chapters on carbohydrates, proteins, oils and waxes

Since the author has wisely recognised that no one person can write with authority on the multifarious processes of chemical industry, he has enlisted the aid of ninety different authorities, and this help is amply justified by the excellence of the monographs. It has not, however, saved the book from certain omissions, such as of streamline filtration, submerged flame combustion and the use of esparto in paper-making, from a number of vague statements, for example, "white paper is made from approximately pure cellulose" and "tung oil is used in varnishes in connexion with pine resin which has been esterified with glycerin", and from a few serious errors such as in the definitions of the Reichert-Meissl and Polenske values of an oil

Apart from such blemishes, the book may be recommended as collateral reading for students of pure science and possibly also, as the author suggests, as a reference book for business men.

J. G

Ronay. a Description of the Islands of North Rona and Sula Sgeir, together with their Geography, Topography, History and Natural History, etc.; to which is appended a Short Account of the Seven Hunters, or Flannan Islands. By Malcolm Stewart Pp xi+73+17 plates. (London: Oxford University Press, 1933) 7*s*. 6*d*. net.

FEW people know of the existence of three uninhabited lands off the north-west coast of Scotland almost as isolated as St. Kilda These are North Rona, Sula Sgeir and the Flannan islands, seven in number with innumerable rocks. North Rona is a cliff-bound island rising up to 355 ft. and about 300 acres in extent; Sgeir is about 30 acres and 229 ft. high; and the Flannan 100 acres between them, with a height of 288 ft. on

Eilean Mor where there is a lighthouse All are formed of horneblende gneiss intersected by pegmatite veins and all probably came under the influence of the quaternary ice, for many fragments of alien rock have been found on each Sgeir has a gannetry with a population of 8,000 to the south of the island, its other birds consisting of as many razorbills and guillemots as well as puffins, kittiwakes, shags and fulmar; as on all such bird islands, vegetation is very scanty. The islands are visited every year from Lewis, Sgeir for young gannets and eggs, the others mainly for the fattening of a certain number of sheep transported from Lewis

Formerly, all would appear to have been inhabited, for they have the remains of unmortared stone houses These were half-sunk into the ground at Rona and were entered by crawling along passages Often large slabs of stone were used, and these would appear to have been turfed over, the only roof-opening being the smoke hole. There is also the remains of a chapel at Rona, now scheduled as a monument The author is not much interested, but the houses described as known to have been recently inhabited are very strikingly like the dolmen of Locmariaquer and Carnac and many other regions In conclusion, there is a short bibliography, but there is clearly a field here for the trained archæologist

Gas Analysis by Measurement of Thermal Conductivity By Dr. H A Daynes Pp viii+357 (Cambridge: At the University Press, 1933) 16*s* net

THE method is based on the discovery by Andrews in 1840 that changes in the composition of gas surrounding an electrically-heated wire are reflected in changes in the electrical resistance of the wire, and may therefore be measured on a suitably calibrated electrical instrument Thanks largely to the developmental work of Shakespear and the Cambridge Instrument Co in England, as well as to that of certain firms in Germany and the United States, it has now attained the status of a recognised industrial method, and as such is well worthy of a monograph to itself

The author is an authority on the subject, and his treatment of the theory, technique and applications of the method is all that could be desired The applications include flue- and fuel-gas control and measurements in connexion with the production of liquid air, gas permeability, for example, leakage through rubber and aircraft fabrics, nitrogen fixation, etc On account of the suitability of their thermal properties, carbon dioxide and hydrogen are frequently mentioned, and a number of useful indirect methods are described for the determination of other gases in terms of these

Possibilities of the method in academic research, for example, in physiology, are also indicated, and it is no exaggeration to state that there is something of interest here for every scientific worker, whatever his sphere and even if he is already using the method. J. G.

The Gyroscopic Stabilization of Land Vehicles By Dr. J F S. Ross Pp vii+172 (London: Edward Arnold and Co, 1933) 14*s* net

THIS book consists of a thesis approved for the degree of Ph D. in the University of London, and it gives the results of an investigation undertaken with the following objects "(i) To determine whether monorail traction is scientifically sound and definitely practicable, (ii) To show why the efforts of inventors have hitherto only met with partial success, and (iii) To place the whole subject on a more scientific footing and to give it a more complete and orderly treatment than it had yet received"

The text is, like most original papers, not easy to read, there are many places where the development would have been greatly enhanced by the insertion of explanatory paragraphs An excellent summary of the author's conclusions with references to the text is given at the end, together with a full bibliography and list of patents

The Flora of the Liverpool District Edited by C Theodore Green Pp xi+163+201 plates (Arbroath T Buncle and Co, 1933)

DR C T GREEN, the editor, thirty years ago, of the first edition of the "Liverpool Flora", is to be congratulated on the completion of this new and revised edition, also under his editorship

The general plan of this well-known flora remains unchanged Miss Wood's admirable line drawings, which express the 'look' of each plant in a most remarkable way, are still one of its most attractive features, though their reproduction is noticeably inferior in this edition. The chief innovation is the inclusion of five special articles on areas of particular interest, such as the Southport sand dunes, with notes on their topography and flora, illustrated by photographs. There are other small alterations, while, of course, a number of additional localities and records are given It is a volume which should be in the possession of all interested in this botanically rich area of Lancashire

Human Values in Psychological Medicine. By Dr C P. Blacker (Oxford Medical Publications) Pp viii+179 (London: Oxford University Press, 1933) 8*s* 6*d* net

THE author defines pivotal values as those which, in one way or another, unify and justify life, give it coherence and make it on the whole worth living. His conception of pivotal values is the really dominant idea of his book. After a number of chapters devoted to the discussion of values from a psychological point of view, the author studies the clinical aspects of the problem. He found that æsthetic values play a small part in the lives of working-class patients. He divides pivotal values into values which are neither religious nor philosophical. We are inclined to disagree with the statement that the majority of hospital patients have no "pivotal values". There are few people who have no pivotal values if only they can be touched on.

Hormones of the Anterior Lobe of the Pituitary Gland

IT is now generally admitted that the functions of the pituitary gland (or hypophysis) are mediated by the secretion of a number of hormones from its different parts, although no active principle has yet been isolated in the pure state, the fractionation of extracts has led to the preparation of solutions having only a part of the physiological activity of the original extract Differences of opinion exist as to the number of hormones actually present, which can only be settled when they are finally isolated as chemical individuals Our knowledge of the functions of the posterior lobe preceded that of the anterior, but within the last few years, with improvement in both chemical and surgical technique, and also following the discovery that hormones regulating certain of the sexual activities of the body are excreted in the urine, great advances have been made also in our knowledge of the functions of the anterior lobe

It appears probable that a number of different hormones are secreted by this lobe, but attention has been directed especially to those stimulating growth and the sexual glands One of the pioneers in this work has been H M Evans, of the University of California, the results of his researches, carried on over the last decade, are now available for study, in the form of a detailed monograph* Although the association of overfunction of the pituitary with body overgrowth (gigantism or acromegaly) and of its underfunction with dwarfism has been frequently confirmed, it was not until 1921 that Evans and Long succeeded in preparing an extract of ox anterior lobes which stimulated growth in mammals This was due to the facts that the growth hormone is a complex substance chemically resembling the proteins, is extraordinarily labile and can only be detected when administered frequently and parenterally to suitable animals Adult female rats more than five months old (which have therefore ceased to increase in weight), are injected intraperitoneally daily for a period of 20 days, groups of four to six animals are used and they are weighed every five days Gains in weight of 25–100 gm can be obtained according to the dose given, the relationship between the logarithm of the dose and the gain in weight was found to be approximately linear. E Biering and E Nielsen (*Biochem. J*, 26, 1015, 1932) have compared the composition of injected growing rats with that of normal growing rats and find that the former show a greater retention of water, but that the solid matter assimilated to the body tissues contains a much greater proportion of protein and less of ash and fat than that laid down by normal animals About three quarters of the gain in weight of the injected animals is due to water retention, and three quarters of the dry matter deposited consists of protein

The method of extraction recommended by Evans and his co-workers is briefly as follows frozen ox anterior lobes are minced and extracted with water made alkaline with baryta, the mixture is centrifuged and the solution brought to pH8 with sulphuric acid and again centrifuged The solution is then acidified and poured into excess of acetone, the precipitate is filtered off and dried. This powder is stable but still contains the gonad stimulating hormone On extraction with 95–98 per cent acetic acid, the latter is destroyed and the growth hormone can be precipitated from solution by acetone in the presence of quinine sulphate Trichloracetic acid precipitates the growth hormone and part of the gonad stimulating hormone from aqueous solutions of the powder, in the supernatant fluid the latter can be obtained free from the former by precipitation with flavianic acid, which is then removed by 80 per cent alcohol containing 1–2 per cent ammonia The purer growth hormone preparations are highly active in a daily dose of 5 mgm

Hypophysectomised rats show a greater response to the growth hormone regardless of age or length of time after removal of the gland Experiments with a hypophysectomised puppy are also described, the pituitary gland was removed when the animal was 8 weeks old, the operation was followed by complete cessation of growth Daily intraperitoneal injections of the growth hormone resulted in a marked increase in weight and size, so that the animal finally became larger than its litter mate control Signs of acromegaly, however, did not develop The ovarian follicles showed considerable development and the thyroid was hyperplastic Similar injections into a normal female resulted in the development of partial acromegaly, some gigantism and diabetes mellitus A male, however, only developed adiposity In dachshunds, the injections increased the size of the animals owing to increase in size of the skull and vertebræ, but the achondroplastic form of the short extremities was not altered, a male developed diabetes The only outstanding acromegalic feature was a folding of the skin of the head and extremities These results lend strong support to the generally accepted view that gigantism and acromegaly in human beings are due to over-secretion by the anterior lobe of the pituitary gland

The gonad stimulating hormone (or hormones) is responsible for the normal development and maintenance in a state of functional activity of the sex glands, with the accessory organs and secondary sex characters. In the female the ovaries themselves respond readily to the hormone, in the male the accessory organs show the most striking effects Immature female rats were used by Evans and his colleagues for the assay of their preparations, injections were made on three days, the vaginal orifice examined on the fourth and fifth days, smears being taken as soon as it had opened, and the animals killed and examined about 96–100 hours after beginning treatment.

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* The Growth and Gonad-Stimulating Hormones of the Anterior Hypophysis By H M Evans, K Meyer and M E Simpson, in collaboration with A J. Szarka, R I Pencharz, R E Cornish and F L Reichert Memoirs of the University of California. Vol 11. Pp 446 (University of California Press Berkeley, California, 1933)

The hormone was prepared from ox anterior lobe (a poor source), from the serum of pregnant mares (a good source), and from the urine of pregnant women. The acetone powder from the alkaline extract of anterior lobes is dissolved in water and the reaction of the solution adjusted to give maximum precipitation: *the greater part of the hormone* remains in solution and is precipitated by flavianic acid, which can be removed afterwards by use of alcohol-ammonia mixture. Alternatively, the powder may be extracted with 50 per cent pyridine, 50–60 per cent alcohol or acetone containing 2–4 per cent ammonia, the hormone is then precipitated by increasing the alcohol or acetone to 85 per cent and adding a little acetic acid or salt. Pregnant mare serum was treated directly with acidified acetone and the powder purified by the methods used in the case of preparations from anterior lobes. From the urine of pregnant women the hormone (called prolan by Aschheim and Zondek its discoverers), was precipitated by excess of alcohol. The precipitate was extracted with dilute acid and the prolan reprecipitated with alcohol, the powder was purified by extraction with acetone-ammonia mixture. The minimum dose of the purest preparations was about 0·05 mgm.

Although preparations from these different sources all stimulate the gonads, yet they show differences in their chemical properties and biological effects. Prolan, for example, is more sensitive to both acid and alkali than preparations from pregnant mare serum; the latter, but not the former, give off hydrogen sulphide on treatment with alkali. However, the differences in chemical properties may be due to differences in the associated impurities. Differences in the biological effects produced are not so easily explained. Even though the minimal doses of different preparations may be the same, larger doses may have widely different effects on the ovary: thus increasing the dose of prolan increases the size of the ovaries at most four times, whilst with preparations from pregnant mare serum, there is a rough proportionality between dose and size up to about twenty-five times the minimal dose.

Evans and his co-workers have not been able to separate the gonad stimulating hormone into follicle stimulating and luteinising factors, corresponding to the *prolans A* and *B* of Aschheim and Zondek. A solution which is predominantly follicle stimulating at one dose level may produce corpora lutea at another level or when the injections are continued beyond the usual three-day period, the predominant effect may depend on the amount of purification to which the extract has been subjected. The type of response also depends in part on the time at which the examination is made after beginning the injections. There are indications that the presence of corpora lutea inhibits further development of the ovary: the occurrence of ovulation depends on the size of the ovary and the dose given. Hypophysectomised female rats were less sensitive than normal animals and the response to prolan was much less than that to extracts of pregnant mare serum; simultaneous administration of the growth promoting hormone diminished the response. Substitution therapy failed to induce the rhythmic changes in the vagina characteristic of the œstrous cycle, a continuous œstrous reaction only being obtained. Pregnancy was not observed owing to failure of implantation, but it could be maintained in animals, hypophysectomised after implantation, by injection of mixtures of growth- and gonad-stimulating hormones.

In hypophysectomised female dogs, prolan had no effect on the genital system even in large doses, and when the system showed a marked degree of atrophy, an anterior lobe extract also had no effect. A mixture of the two preparations, however, stimulated the genitalia within ten days; the vulva increased to a size greater than that observed in normal œstrus in a litter mate control, the mammary gland and uterus showed marked development and the ovary was much enlarged and contained many corpora lutea. This result may be contrasted with some experiments on the hypophysectomised ferret recently published by M. K. McPhail (*Proc. Roy. Soc.*, B, 114, 128; 1933). Anterior lobe extract alone produced extensive theca luteinisation of small follicles, but no development of large follicles: prolan alone caused many follicles to undergo partial growth, which, however, terminated in atresia: the vulva showed partial œstrous swelling. A mixture of the two preparations produced usually only theca luteinisation.

Without referring to other work in detail, it may be stated that several workers in addition to Aschheim and Zondek have adduced evidence that the follicle stimulating and luteinising hormones from the anterior lobe are separate entities. The synergistic action with prolan may depend on the proportions of these factors present in different preparations. Apart from the chemical difficulties of preparing the hormones in a pure state, the facts that they act in succession, or if really a single entity initiate a series of reactions, introduces a complication into the evaluation of the biological tests, which only further work with a standardised technique can clarify.

In immature male rats, doses of gonad stimulating hormone sufficient to produce enlargement of the ovaries in immature females produced little or no increase in the weight of the testes, although the accessory organs grew markedly and attained the size characteristic of these organs in young adults. Larger doses of hormone, however, increased the weight of the testes. Senile males also responded by increase in weight of the accessory organs. In hypophysectomised males injections of the hormone caused regeneration of the atrophied testes, the seminal vesicles became enlarged and filled with fluid and spermatogenesis was resumed; the replacement therapy was complete since normal litters were sired, and the testes appeared normal on histological examination

The atrophy of the thyroid and adrenal glands after removal of the pituitary was not repaired by injection of gonad stimulating hormone, but extracts containing the growth hormone maintained or restored the weight of these organs, although histologically the normal structure was not completely regained Evans's results do not show whether it is the growth hormone or some other active principles in the extracts which are responsible for these effects The cachexia commonly observed in hypophysectomised rats was also relieved by injections of the growth hormone.

The data on which the workers in the University of California base the conclusions briefly reviewed above are available in detail in the monograph now under notice The methods described should be of value to other investigators and their results should form the basis of further research in this important field

The British Association Tables of Bessel Functions

IN 1888 a Committee was appointed by the British Association for the purpose "of considering the possibility of calculating tables of certain mathematical functions, and, if necessary, of taking steps to carry out the calculations, and to publish the results in an accessible form" The Committee had the late Lord Rayleigh for chairman, and 'Mr ' A Lodge for secretary, and the other members were 'Sir W Thomson', Cayley, Price, Glaisher, Greenhill and Hicks Bessel functions were among the functions considered, and their calculation became the chief work of the Committee. Tables appeared in the Reports of the Association for 1889, 1893 and 1896 In 1907 the Committee reported on "The further tabulation of Bessel functions", and in 1909 stated that it was "also considering the advisability of collecting all existing tables of Bessel functions and publishing them in a form easily accessible to all students" During the next few years tables of Bessel functions of various types appeared regularly, and in 1915 it was reported that "the order of calculation is being arranged in accordance with the real urgency of the tables, and the stage is now coming in sight at which the Committee will be able, as authorised already by the Association, to publish a volume of fairly complete tables of the more important transcendental functions".

The Committee's hopeful plans, like others, were, however, hurled to emptiness, and although the Committee remained in existence and many tables were printed in its reports, it was not until after the Glasgow meeting of the Association in 1928 that the preparation of the long foreseen volume was taken seriously in hand; and when in 1931 a volume appeared, it contained no tables of Bessel functions. The reasons for this, and the problems confronting the Committee, were explained in the preface:

" . . It was apparent from the first that the simple plan of reprinting existing material would produce a volume neither useful nor creditable There were gaps in the ranges of the arguments of some of the functions, natural when the tabulation had been performed at different times for special purposes, but intolerable if tables were to be issued for general use. In the case of the Bessel functions, the functions tabulated did not form in any sense a complete collection. Lastly, the original tables offered no facilities for interpolation Two years ago the Committee decided that these difficulties must not impede publication indefinitely, and that, if the Bessel functions were reserved for an independent volume, definite progress could be made "

Since 1929, therefore, the work on Bessel functions has been independent both of the preparation of volumes of tables of other functions and of the computation from time to time of special tables in response to current demands The aim of the Committee is to publish as complete and uniform a set of tables of Bessel functions as possible, the majority will be derived from the reports, but several will be new It is estimated that the tables will extend to nearly five hundred pages, and it is proposed to issue two volumes, partly to avoid an unwieldy book and partly to expedite publication The material for the first volume is in an advanced state, more than three-quarters of the estimated 280 pages being ready for the printer

Unfortunately, financial difficulties have now to be overcome It is not to be expected that an undertaking of this sort can be a paying proposition The mathematicians concerned have given their services, but the mere cost of production will be between 30*s* and £2 a page The calls on the British Association are far more miscellaneous, far more extensive, than in the spacious days when £500 could cheerfully be voted for a single object At the moment, a sum of £150, which includes a grant of £50 from the Royal Society for this purpose, has been set aside by the Council of the Association, but this is little more than an earnest of belief in the Committee's plan Unless further help is forthcoming, there is a serious danger that the enterprise to which a multitude of volunteers have given their leisure during nearly half a century will be completed by the enthusiastic drudgery of the Committee which has accepted it as a heritage, only to rest—a manuscript almost too precious to be consulted—in a fire-proof safe. It ought to be sufficient, by directing attention to this possibility, to ensure that funds will be provided to enable the two volumes to be published and thus to make available the results of so many years of voluntary work on behalf of mathematical students and others.

Effect of Low Temperatures on Metals

SINCE the year 1905, when Sir Robert Hadfield and the late Sir James Dewar described the effect of liquid air temperatures on the strength of iron and its alloys, there has been not only a very considerable advance in low temperature technique, but also many types of new metallurgical materials have been successfully developed Many alloys which are to-day in extensive use as parts of machines and structures were quite unknown at the time of that research

The importance of low temperature research was recognised many years earlier than 1905 in view of the severe winter conditions experienced in northern Continental lands In research work of the future, still greater attention is likely to be paid to the study of low temperature phenomena in relation to the physical and engineering sciences

Recently Prof. W J de Haas and Sir Robert Hadfield[*] have described to the Royal Society the results of a further important research on the mechanical properties of these materials at the boiling point of liquified hydrogen (–252 8° C) This work has extended the range of study of the properties of metals a further 60° C and thus the strength of these metals is now known at 20 3° K At this low temperature, changes in the properties of some of the metals have occurred, but the present work does not show any marked discontinuity in general properties corresponding to the sudden fall in electrical resistivity which exists in some metals near to the boiling point of liquid helium The possibility of the use of liquid helium has for the moment been postponed on account of the large quantities that would be needed to effect cooling If its use is later found to be practicable, tests would be made as low as 4 2° K On small specimens a study was made at this temperature in 1921 in collaboration with the late Prof Kamerlingh Onnes and H R Woltjer In those experiments they showed the absence of magnetic transformations in the iron-manganese alloys, whereas the iron-nickel alloys exhibited the presence of polymorphic transformations

Prof de Haas has designed the testing apparatus for this work, immersing the specimens in liquified hydrogen contained in a Dewar flask. The testing stress has been applied by an oil cylinder through a tension rod sliding inside a concentrically mounted tube Into the ends of these two members the specimen holders have been fitted

The specimens selected for examination not only included the materials which had previously been tested in liquid air, but also many recently developed alloys which exhibit a combination of high strength and ductility.

At liquid air temperatures, many ferrous materials, including iron itself, show a marked increase in tenacity, and in general these same ferrous materials show a continued fall in ductility, which becomes negligibly small at the boiling point of hydrogen At this temperature there is an apparent fall in strength There are, however, some remarkable exceptions to this fact, for example, an alloy containing 6 per cent of manganese and 24 per cent of nickel shows an increase of ductility when cooled to –194° C , and on being further cooled to the boiling point of hydrogen, it still retains appreciable ductility This present work thus continues the study of the iron-nickel-manganese-carbon alloys which were described in the seventh report to the Alloys Research Committee of the Institution of Mechanical Engineers in 1905

The 'stainless steels' and 'high temperature alloys' are two classes of materials which are not adversely affected by fall of temperature , for example, the well-known alloy containing 18 per cent of chromium and 8 per cent of nickel shows the remarkable strength of 119 8 tons per square inch, accompanied by an elongation of 25 per cent

The non-ferrous alloys which the authors have selected are all ductile at the lowest temperature of test The earlier work had shown that nickel, copper and aluminium increased in strength without a corresponding fall in ductility In the present tests, the copper specimens break at 29 7 tons per square inch accompanied by a ductility of 60 per cent in extension, but a bronze, containing 10 per cent of tin, shows a slight reduction in properties Good extension occurs during test of specimens of an '80/20' nickel-chromium alloy and of the aluminium alloy known as 'duralumin' The safety of the aluminium alloy from embrittlement will be a guidance to designers of aircraft

A consideration of the non-ferrous alloys selected for test shows that these possess a lattice structure of the face-centred cubic type which appears to allow the retention of ductility at low temperatures, but in ferrous alloys this arrangement of the atoms is not always accompanied by ductility ; for example, the toughened manganese steel and the low carbon alloy of this metal with iron, are not ductile, although their structures conform at normal temperatures to the face-centred form of the cubic system The embrittlement of austenitic manganese steel appears to be entirely unaccompanied by metallographic change of a permanent character, for the material reverts to a ductile state at normal temperatures On the other hand, austenitic nickel steels show a change which is irreversible.

The iron alloys of the ferritic type have a body-centred lattice and are not ductile at low temperatures These materials contrast very strikingly with the austenitic 'stainless' and 'heat-resisting' steels, which possess a face-centred cubic structure and are not embrittled

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[*] "On the effect of the Temperature of Liquid Hydrogen (–252 8° C) on the Tensile Properties of Forty-One Specimens of Metals comprising (*a*) Pure Iron (*b*) Four Carbon Steels (*c*) Thirty Alloy Steels (*d*) Copper and Nickel (*e*) Four Non-Ferrous Alloys." By Prof W J de Haas and Sir Robert Hadfield *Phil Trans Roy Soc* , A, 232, 297–332 ; 1933.

Obituary

PROF. ALBERT CALMETTE, For Mem R S

ALBERT CALMETTE, sub-director of the Pasteur Institute, who died on October 29, 1933 after a short illness, was born at Nice on July 12, 1863 After graduation, he entered the medical service of the navy and spent seven years in Eastern waters As a naval surgeon, he became interested in the numerous hygienic problems of France's colonial possessions In 1889 he was transferred to the new colonial medical service and was given permission to go to the Pasteur Institute There he came under the influence of Pasteur, and took Roux's course of lectures in bacteriology and became one of his most enthusiastic pupils His progress was so rapid that the next year he was chosen by Pasteur to proceed to Saigon to found the first of the daughter Pasteur institutes

At Saigon, Calmette was occupied with the study of cholera and bacillary and amoebic dysenterics It was here, too, that he first became interested in snake venoms The number of deaths from cobra-bite was serious and the director of the new institute was appealed to for help by the administration

In 1893 Calmette returned to France and continued his work on the action of cobra venom This was followed up by experiments to ascertain whether the serum of an animal immunised against the venom contained anti-toxins and could be exploited for treatment Sewall had shown that immunity followed repeated small injections of the venom of the rattlesnake, and Behring had a few years previously established the anti-toxic value of the serum of animals treated in a similar manner with the toxins of the tetanus and diphtheria bacillus It seemed, therefore, not unlikely that an anti-toxic immunity would be aroused by the injection of snake venom

Before the end of 1894 Calmette was successful in demonstrating that by patiently immunising horses with increasing doses of cobra venom they accumulated sufficient antitoxin in their serum for the latter to be used as a remedy for snake-bite As most venoms were similar in their actions, Calmette at first supposed that serum prepared by injecting cobra venom would be of value to counteract the effects of the poisons of other kinds of snake. He was rather obstinate in adhering to this opinion in the face of experimental evidence from Australia, India and Brazil that such was not the case but that anti-venoms were highly specific.

In 1895, Calmette's enthusiasm and organising ability was again taken advantage of and he was chosen to establish a Pasteur Institute for the north of France at Lille The new institute was to be a subsidiary centre for anti-rabic inoculation and the preparation of diphtheria antitoxin and vaccine lymph. Under Calmette's guidance, it soon became an active centre of research. From the point of view of sanitation, the industrial town of Lille was not progressive Its water supply and methods for the disposal of sewage were unsatisfactory The incidence of tuberculosis was high and invalidism from hook-worm in the neighbouring coal-mines was serious Calmette, who was appointed professor of hygiene a few years after his arrival, worked vigorously to improve the sanitary condition of the town He instituted investigations into the bacterial treatment of sewage and various methods for the purification of water supplies He was successful in inducing the municipal authorities to undertake some measure of improvement He made a useful research into hook-worm, and his method for combating this disease in miners is that now usually followed elsewhere

How to diminish the damage to health and life caused by infection with the tubercle bacillus was a more serious problem Calmette established a tuberculosis dispensary, the first in France, for the early diagnosis of phthisis and for the education of patients in habits to minimise the familial spread of the disease He was instrumental in providing a sanatorium for early, and a colony for advanced, cases of the disease These measures, however, did not strike at the root of the matter and the idea of attacking the problem by some immunological procedure was always present in his mind All efforts to produce resistance by the inoculation of killed cultures of the tubercle bacillus having proved unsatisfactory, he turned his attention to the possibility of employing a living attenuated culture as Pasteur had done in the case of anthrax His goal was to produce a strain of the bacillus so much deprived of its virulence that it would not produce tuberculosis when introduced into animals but only a mild illness, recovery from which inevitably occurred It was hoped that by this experience the body would acquire the power of dealing satisfactorily with a subsequent infection by virulent microbes

In 1903, in collaboration with his assistant Guérin, Calmette began the researches which ultimately resulted in the now famous strain of bovine tubercle bacilli designated B C G (Bacillus Calmette Guérin) This strain was produced by successive propagation of an ordinary bovine type of bacillus on potato soaked in bile Its stabilisation took thirteen years, during which 230 successive cultivations were made. At the end of this time, the strain was found to be incapable of producing tuberculosis in animals and to remain devoid of this power as long as it was cultivated on the bile-media

By 1914 the experiments of Calmette and Guérin had convinced them that cultures of B C G. could be used to induce resistance to tuberculosis in cattle. At this stage, their researches were perforce suspended by the outbreak of War. During the occupation of Lille, Calmette came under suspicion because he kept numbers of pigeons in his laboratory. He suffered regrettable indignities at the hands of the military authorities and his wife was removed to Germany as a hostage. During this unhappy period, he occupied himself writing an interesting book on the pathology of tuberculosis, in which he presented his observations and developed his theory of the nature of acquired resistance to the disease.

On the death of Metchnikoff in 1917, Calmette was elected sub-director of the Pasteur Institute but did not undertake the duties of this office until after the War. At Paris he continued his researches on protection against infection by the tubercle bacillus with increased fervour and enlarged opportunities.

To understand the subsequent progress of these researches it is necessary to epitomise his conception of the means by which individuals acquire their resistance to the tubercle bacillus. Both evidence from post-mortems and the results of the skin reaction of von Pirquet to tuberculin indicate that the majority of individuals by fifty years of age have at some time in their life been infected, although they may not have shown symptoms of tuberculosis. Calmette believed, and had experimental evidence to support his belief, that a very small number of infecting bacilli is not, in most individuals, followed by manifest tuberculosis and is recovered from, leaving the body more capable of resisting a subsequent dose. In this manner by a succession of small infections an immunity is acquired.

Immunisation by chance is, however, a highly dangerous way of attaining resistance, for, at any time, the dose may be sufficiently large to break down the individual's resistance and tuberculosis ensue. Calmette therefore advocated that the wise procedure would be to accustom the body to resist invasion by the tubercle bacillus by giving its immunological mechanisms opportunities to obtain practice with an innocent tubercle bacillus before the nearly inevitable inroad of a virulent one took place, much as it is well to acquire expertness as a toreador with de-horned cattle. To do this he suggested that young babies should be given minute doses of his attenuated B C G. culture by mouth before they have had an opportunity to ingest virulent bacilli, a procedure he calls 'premunition'.

In 1922 Dr. Weill-Hallé treated 314 infants, the progeny of tuberculous mothers. The treatment was inoffensive and a comparison of the tuberculosis rate amongst treated and untreated infants from similar environment was deemed to be promising. The treatment was begun 3 days after birth to minimise the chances of the infants being infected by virulent bacilli from their mothers prior to receiving the strain B C G. Since then upwards of a million babies have been treated in France and elsewhere, and apart from the tragedy at Lubeck, where by carelessness at the hospital, some 250 infants were fed a dose of a culture of virulent human tubercle bacilli by mistake and 73 died, no untoward happening has been recorded. At the present time some 150,000 infants are treated annually in France alone and the council of the Pasteur Institute has erected a vast building for the preparation and distribution of cultures of B C G all over the world.

Unfortunately, the resistance obtained from one treatment is not permanent and has to be repeated after one or two years. This makes it more difficult accurately to assess the results of the treatment for some years to come. The figures recorded are susceptible of statistical criticism, but the numerous practitioners who have employed the treatment are very generally convinced that it is followed by a decline in the incidence of tuberculosis and also by a diminution of the general mortality during the early years of life. To what extent this promise is justified will emerge in a few years, when the after-history of the million infants already treated is known. Whatever this verdict is, Calmette's endeavours to mitigate the ravages of tuberculosis will remain the magnificent effort of a man who devoted his life to the pursuit of science for the service of mankind. C. J. M.

MR. J. B. HOBLYN

By the death on December 24 of John Bright Hoblyn, in his fifty-fourth year, the automobile engineering industry has lost one of its best known scientific personalities. During his eighteen years' association with Messrs. Vauxhall Motors Ltd., of Luton, he had become a prominent figure in the fields of metallurgy and petroleum technology, and his ready flow of witty and pungent speech—and, on occasion, of scathing criticism—made him an attractive lecturer and debater.

An old student of the Royal College of Science, Mr. Hoblyn was for eleven years science master at Luton Modern School. In 1915 he accepted an invitation to join Vauxhall Motors Ltd. as chief chemist and metallurgist, and he promptly applied himself to the chemical and metallurgical problems of automobile engineering. His publications included three papers of outstanding importance to the industry, dealing respectively with the heat treatment of steels, the oxidation of lubricating oils and the development of aluminium alloys for automobile construction. His work on lubricating oils opened up a new avenue in the testing technique of these products.

For several years past Mr. Hoblyn had been chairman of the committee set up by the Institution of Automobile Engineers for the rationalisation of automobile steel specifications, and at the time of his death he had almost seen the completion of his labours in this field. L. B. H.

We regret to record the death of Prof. J. E. G. de Montmorency, Quain professor of comparative law in the University of London in 1920–32, whose studies of primitive law formed valuable contributions to anthropology, on March 9, aged sixty-seven years.

News and Views

Gottlieb Daimler (1834–1900)

ON March 17 the centenary occurs of the birth of Gottlieb Daimler, the distinguished German engineer, to whom we owe the introduction of the light high-speed spirit engine suitable for road vehicles. After a varied practical experience as a mechanical engineer, Daimler in 1872, at the age of thirty-eight years, became associated with Langen and Otto, who were then engaged on the improvement of the gas engine, and Daimler's own contribution to the progress of the internal combustion engine is but an illustration of how invention begets invention. His death took place thirty-four years ago, before motor-cars had ceased to be novelties in the streets, but of the millions of cars to-day every one owes something to Langen, Otto and Daimler and their collaborator, Maybach. Daimler was born at Schorndorf, Wurttemberg, and at the age of nineteen years began work in a machine tool factory. From 1857 until 1859 he was a student at Stuttgart Polytechnic; from 1861 until 1863 he worked in England and then held positions in works at Geislingen and Karlsruhe. The turning point in his career came when in 1872 he joined Langen and Otto as technical manager of the Gasmotorenfabrik Deutz A.G., near Cologne. The firm had already achieved considerable success with its atmospheric gas engines and Otto was engaged on the experiments which led him to the invention of the four-stroke engine, patented on August 4, 1877, and to the manufacture of the world-famous 'Otto' gas engines.

IN these developments Daimler played an important part, and visualising the possibility of applying internal combustion engines to vehicles, in 1882 he left the Deutz concern and with his friend and colleague, Wilhelm Maybach, set up an experimental workshop at Cannstatt. By August 1883 he had built a four-stroke engine using benzine, running at 900 r.p.m., and on December 16, 1883, he took out his patent. He next proceeded to fit high-speed engines to a form of bicycle, to a four-wheel carriage and to a boat. By this time, Karl Benz of Karlsruhe had also produced a motor-driven three-wheel vehicle, and it is thus to this group of German engineers that the world owes the birth of the motor-car. The Benz cars, the first to be made in any considerable numbers, were exploited in Paris by E. Roger, while the manufacture of Daimler cars was taken up by Panhard and Levassor, whose early design, with the engine in front, has been followed generally ever since. After selling the French rights to the use of his patents, Daimler in 1890 founded the Daimler-Motoren-Gesellschaft at Cannstatt, of which for a considerable time Maybach was the manager, Daimler acting chiefly in an advisory capacity. Daimler's death took place at Cannstatt on March 6, 1900. Two years later, the Württemberg branch of the Verein Deutscher Ingenieure placed a memorial to him in the gardens at Cannstatt where, in 1885, Daimler had driven his first automobile.

Sir James Hector (1834–1907)

SIR JAMES HECTOR, the first director of the Geological Survey of New Zealand, a post he held from 1865 until 1905, was born at Edinburgh a century ago on March 16. The son of a writer to the signet, he was educated at Edinburgh Academy and the University and in 1856 took the degree of M.D. After acting for short periods as assistant to Edward Forbes and Sir James Simpson, in 1857 he was, through Murchison, appointed surgeon and geologist to Capt. John Palliser's expedition to British North America. During this expedition he discovered Hector Pass in the Rocky Mountains and directed attention to the evidence of glaciation and the existence of erratic blocks. In 1860 he sailed for New Zealand to take up the appointment of geologist to the Government of Otago. The services of von Haast (1824–87) and von Hochstetter (1829–84) had already been secured by the colonial authorities, and it was by these three men, together with J. W. Hutton (1836–1905), that the geology of the Islands was first unravelled. In 1865 Hector became director of the Geological Survey and of the Colonial Museum at Wellington, which remained his headquarters for the rest of his life. He was also head of the meteorological service and Chancellor of the University of New Zealand. Elected fellow of the Royal Society in 1866, he was awarded the Lyell medal of the Geological Society in 1875 and in 1887 was made K.C.M.G. In 1891 he served as president of the Australasian Association for the Advancement of Science. He died at Wellington on November 5, 1907.

The Mentality of the African

MR. A. T. LACEY's opening statement in the discussion on "The Genius of the African" which took place at the meeting of the Education Circle of the Royal Empire Society on March 8, gave a clear view of the fundamental factors in the problem which awaits solution in the development of African peoples. As Director of Education in Nyasaland, Mr. Lacey has had an excellent opportunity of forming an estimate of the capacity of a good, but not exceptional, sample of the Bantu peoples, and his conclusions, which recognise the native's limitations without unduly stressing his failings, deserve the careful consideration due to an opinion based on an intimate knowledge of conditions and a clear perception of the forces which make the present moment a critical period for the future of the greater part of Africa. Mr. Lacey agrees with other students of present-day tendencies in Africa in diagnosing the essential element of the problem as a conflict between the mentality of a people whose whole outlook is conditioned by group consciousness and group responsibility, and the type of mentality which is produced by the individualism of a European economic and social organisation. He pointed out that with the native's traditional outlook goes a spontaneous observance of law and order; but to maintain this disciplined attitude in changing conditions and to meet the new individualistic attitude, the group or tribe must now find a new orientation. As an educationist, he, not unnaturally, pins his faith to the individual; and he, therefore, proceeded to demonstrate the educability of the African from the degree and character of the achievement of the natives under his jurisdiction. In rating it relatively high, he is in agreement with others whose acquaintance with the African is not less than his own.

In view of Mr. Lacey's remarks on the place of the family and tribal group in promoting the maintenance of law and order, it is a disappointment to find that he anticipates little assistance from the home environment in the slow process of building up an educational tradition. The pre-European system of native education was largely left to the influence of the social environment, and if the group should attain the new orientation which is said to be a necessity of future development, it should be made to play its part in developing the social consciousness of the rising generations, co-operating with the more academic influence of the official system of education. It is evident that a grave responsibility will rest on the administration in guiding tribal development towards the new orientation along lines which avoid any sudden break with tradition and yet lead towards the full social and religious life which Mr. Lacey postulates as an inspiration for the full expression of the Bantu genius. In this connexion the article on "Kenya Cults" which appeared in the *Times* of March 10 is suggestive. The author of that article describes some of the strange cults which have arisen recently in Kavirondo and among the Kikuyu. Their appearance in Kenya is not unique, but can be paralleled by strange forms of belief which have been grafted on Christianity and have attracted a large number of followers from time to time in other parts of Africa, and it will be remembered that it was a dispute, similar to that now described, but on a much larger scale, between the followers of Roman Catholic and Protestant creeds which first led to European intervention in Uganda. It is suggested by the writer in the *Times* that the Kenya cults are matters for the anthropologist rather than the administrator, but against this view, it is a question whether, owing to the tendency of the African towards fanatical adherence to aberrant and anti-social cults, the attitude of the administration towards developments in native religion does not require fundamental revision.

24-Hour Time System

It has been announced that the British Broadcasting Corporation will adopt at an early date the 24-hour system of expressing time. The system will be used in announcements over the microphone, in the journals issued by it and in correspondence. This decision by the B.B.C. will provide the best possible opportunity of testing whether the general public is in favour of or is opposed to the 24-hour system. Though the adoption of the 24-hour system has been widely supported by transport organisations (rail, road and air), by engineers, by the mercantile marine and in scientific circles, the Government has taken the view that there is no very strong demand for the change and that it would be wrong to impose upon the public a system of notation which might confuse rather than assist. As was announced in NATURE last week (p. 354), the Postmaster-General has stated that he proposes to await the result of the B.B.C. experiment before coming to a decision. It was apparently with the same desire to see what measure of support or opposition from the general public was indicated that the House of Lords on March 7 negatived a motion introduced by Lord Lamington urging that the 24-hour system should be put into operation as soon as possible, though the House on December 7, 1933, had approved a motion for the adoption of the system.

Development of the Royal Air Force

Presenting the air estimates to Parliament on March 8, Sir Philip Sassoon, Under-Secretary of State for Air, outlined a programme of expansion of the R.A.F. which, while modest, is probably as large as can be undertaken with efficiency at the present time, remembering that previous economies have restricted both the training of personnel, and the provision of accommodation for additional squadrons. The net amount provided is £17,561,000, an increase of £135,000 over last year's figure. If grants from India and the Admiralty in respect of R.A.F. services to them are added, these figures become £20,165,000 and £527,000 respectively. Four new squadrons are to be formed, two for home defence, one flying boat squadron, and the equivalent of one squadron for the Fleet air arm. In addition, two home defence squadrons, at present forming part of an experimental station, and consequently non-effective as fighting units, are to be reconstituted as active squadrons. The principal increased expenditures are obviously to be made under Votes 3 (technical equipment), and 4 (works, buildings, lands, etc.). It is interesting to note that Vote 2 (non-technical stores) remains stationary, in spite of the expansions, due to lower prices. Vote 8 (civil aviation) stands at the highest figure for the last ten years. This includes expenditure upon the British Government part of the route to Australia, up to Singapore, the first link of the Atlantic service, New York to Bermuda, and the usual subsidies for flying activities in Great Britain. Sir Philip also gave an interesting account of the various developments of the R.A.F., including long distance communication flights, police duties and distress relief in remote lands, air surveying, etc. The use of petrol produced from British coal has been successful, and it is hoped to maintain seven squadrons upon it exclusively during the coming year.

Elements Old and New

In a lecture with the above title given at East London College on March 8, Prof. James Kendall, of the University of Edinburgh, traced the development of fundamental ideas on the elements from the earliest times to the modern period. The four elements of the Greek philosophers—fire, air, earth and water—expanded during the nineteenth century into ninety-two elements of the periodic system, and all these ninety-two are recognised now to be aggregates of two simpler electrical units—positively charged protons and negatively charged electrons Nevertheless, it is interesting to note that chemistry, in its development as a science from alchemy as an art, has passed through four distinct stages, in each of which one of the four elements of Aristotle has been dominant (see NATURE, March 10, p 354)

JUST as atmospheric air was found by Raleigh and Ramsay to contain traces of unsuspected elements—argon, neon, krypton and xenon—so ordinary water has recently been shown to have present in it a minute quantity of a novel compound—*heavy water*. Each hydrogen atom in heavy water comprises two protons and two electrons, or twice the quota of an ordinary hydrogen atom, and this increased complexity involves a significant change in chemical as well as in physical properties Pure heavy water, prepared by a series of fractional electrolyses, has a density more than ten per cent higher than that of ordinary water It freezes at 3 8° and boils at 101 6° C. It retards the development of plant life, and proves fatal to certain lower species of animal life, such as tadpoles and flat-worms What its effect, in pure and diluted form, upon the human organism may be is at present merely a matter of interesting speculation. A very interesting survey was given of the views held on the nature of the elements from the earliest period to the present day, and Prof Kendall suggested that in the future a further phase of development, corresponding with the fifth element of Aristotle, the quintessence or the ether, which survived the other four elements by a century, might recognise the greater importance of radiant energy in chemical processes.

Accidents and their Prevention

A CHADWICK public lecture on "The Causes and Prevention of Human Accidents" was delivered by Dr C. S. Myers, principal of the National Institute of Industrial Psychology, on March 12 Hitherto accidents in factories and on the road have been too often attributed merely to recklessness and carelessness and to dangerous conditions More than 50 per cent of factory accidents (fatal and non-fatal) are found not to be due to dangerous machinery; and it has been estimated that, however much better machinery be guarded, the present factory accident rate of more than 106,000 per annum is unlikely to be seriously reduced by these measures or by more extensive use of safety-first posters. On the road, in spite of improved signals, car controls, regulated speeds of traffic and better lay-out of roads, 216,000 were injured and more than 7,000 killed in Great Britain through car accidents in 1933. At least 80 per cent of all such fatal accidents are attributable to the 'human factor', the study of which in occupational life is the concern of the industrial psychologist. Accidents are not uniformly spread over the population whose actions may give rise to them. In each of two American investigations, it was found that about a half of the total accidents incurred by trams and omnibuses were confined to about a third of their drivers In England, the scores obtained in selection tests for the motor driver devised by the National Institute of Industrial Psychology, have proved to be so highly correlated with the records of the safe driving of motor drivers on the roads, that one well-known insurance company has recently offered a ten per cent reduction in the annual premium for accident insurance to those who have passed these tests satisfactorily Selection methods, however, must be supplemented by adequate knowledge, which can be obtained only by systematic training

New Land in the Antarctic

CONSUL LARS CHRISTENSEN, the Norwegian whaling expert who has done much to encourage Norwegian exploration in the Antarctic, left Cape Town in the whaler *Thorshavn* in December last year for the south He has now returned to Montevideo and, according to the *Times*, announces the discovery of a new stretch of coast line 150 miles in extent, in lat 72° S Unfortunately, the longitude is not given but the land would seem to lie in the unknown sector south of Bouvet Island between Princess Ragnhild Land on the east and Crown Princess Martha Land on the west The hypothetical coastline was there drawn in approximately the latitude of the new discovery, which has been named Princess Astrid Land A further note in the dispatch in reference to soundings in deep water on the supposed site of land suggests that some earlier discoveries may have to be moved south, but no details are yet available

A New Antarctic Expedition

IT is announced in the *Times* that a British Antarctic Expedition will leave England in September for the western side of Graham Land It will be led by Mr J. R Rymill, of the recent Watkins Greenland expedition, who will be accompanied by fourteen men most of whom have had experience in Greenland. They include Messrs. W E Hampton, Q. Riley, A Stephenson, and E Bingham A vessel of about 120 tons, to be manned by the members of the expedition, will sail via Deception Island in the South Shetlands to Wilhelmina Bay in North Graham Land whence, after a reconnaissance by aeroplane, a sledge journey will be made along the east coast to Crane Channel and back Later in the summer, the ship will be taken farther south and a base for two winters will be sought in Marguerite Bay, or farther south in Graham Land or possibly Hearst Land. If a safe harbour cannot be found, the ship will return to Deception Island leaving most of the expedition at a land station From the southern base a sledge journey will start eastward in October 1935, returning about March 1936. It is hoped that this journey will settle the problem of the western coast line of the Weddell Sea In the following summer, sledge journeys, supplemented by aeroplane flights, will be made westward to Charcot Island and beyond if possible. The expedition hopes to return to England in May 1937. This ambitious project, which should solve some of the outstanding problems in Antarctic discovery, is estimated to cost no more than £15,000, of which the British Government is giving £10,000 and the Royal Geographical Society £1,000

Sir Everard im Thurn Memorial Scholarship

THE council of the Scottish Anthropological Society proposes to create a permanent memorial of the late Sir Everard im Thurn by founding a lectureship in anthropology Sir Everard im Thurn was the first president of the Edinburgh and Lothians Branch of the Royal Anthropological Institute, an office which he held from 1924 until 1932, and was one of the first to advocate the formation of a Scottish national society for the advancement of anthropological teaching and research Sir Everard's distinction as an anthropologist has been widely recognised He was the author of the standard work on the Indians of Guiana, contributed numerous papers on anthropological subjects to scientific journals, and was president of the Royal Anthropological Institute in 1919–21 It is intended that the Sir Everard im Thurn memorial lecture should be delivered annually on the date of the annual general meeting of the Society by an anthropologist of note For this purpose, it is stated in an appeal issued by the memorial committee, of which Prof H. J Rose, president of the Society, is chairman, a capital sum of £500 will be required to meet the annual expenses Part of this sum has already been provided, but further subscriptions are invited to make up the amount In the meantime, arrangements have been made for the delivery of the first lecture on May 22, 1934, when Dr R R Marett will lecture on "Sir Everard im Thurn as Anthropologist and as Man" Contributions to the fund should be addressed to the honorary treasurer of the Society, Mr. J B. Mackay, 30 St. Alban's Road, Edinburgh

Work of Geological Surveys

THE presidential address of Sir Thomas Holland at the annual general meeting of the Geological Society on February 16 was mainly devoted to an examination of the organisation of the geological surveys of the British Empire and the United States. He emphasised the fact that the real object of every such survey is the mineral development of the country, scientific results being obtained as by-products and used as a means to attaining the economic object in view. The work of preparing a geological map requires the co-operation of various specialists of at least seven kinds With a director and his assistant, a curator and a chemist, the minimum number of scientific officers required for a survey like that of India, for example, is found to be about 21 Below this standard an organisation is scientifically inefficient and economically wasteful. The colonies separately might not be able, for financial reasons, to maintain this standard, but the difficulty could be partially met, as in the Federated Malay States, by a federation of officers in geographically related groups Important functions of a survey are the classification of public lands and the compilation and analysis of mineral statistics. The director should be well acquainted with the trend of mineral development, watching imports for indications that the country might itself produce certain minerals and by-products He should therefore be the adviser of his Government on questions of mineral policy, whether in purely economic matters or in the development and conservation of minerals that are essential for the production of munitions of war

Science and Society

THE third Hobhouse memorial lecture, on the subject, "Rational and Irrational Elements in our Society", was delivered at Bedford College for Women on March 7 by Prof Karl Mannheim, formerly professor of sociology in the University of Frankfort-on-Main, and now lecturer in sociology at the London School of Economics and Political Science The main theme of the lecture was the problem created for contemporary society through the disproportion between the range of man's technical knowledge, and his moral qualities and rational insight into the social mechanism which it is the task of members of society to control Society must break down unless this grave disproportion be remedied. Owing to the correlation of the growth of certain moral and spiritual elements with certain features in society, the problem is amenable to scientific treatment The question to be answered is what are the elements in an industrialised society which tend to heighten rationality and at the same time to promote irrationality. Two senses of rationality must be distinguished. Substantial rationality relates to thinking and understanding, to the cogitative elements in general; functional rationality relates to the organisation of activities for the attaining of given ends calculated from the point of view of a given observer. Modern industrialised society has revealed the power to plan and control possessed by those who are emotionally primitive. Our society is faced with the problem of planning the man who has to plan men. Its future depends upon the group within society which has the ability to control, and the energy to subdue the irrational elements

Birmingham Museum

THE City of Birmingham Museum and Art Gallery, which celebrates its jubilee this year with a series of special exhibitions, the first of which was opened on February 24, may be said to have had its origin in the presentation of Edward Coleman's painting, "Dead Game", by a body of subscribers in 1864, an Art Gallery formed in a room of the Free Library being opened to the public in August three years later In 1870, £1,000 was raised towards the formation of a Museum of Industrial and Decorative Art, but the establishment of a natural history museum was not mooted until 1887 The project received little support as Dr. Sans Cox had already established a collection at Queen's College, which was later handed over to the corporation. In 1904, however, the City Council decided to allocate the upper floor of the new Art Gallery building, facing Congreve Street, for a natural history museum.

The principal gifts that followed were the Blatch collection of Lepidoptera, presented by Sir George Kenrick, a collection of British and foreign bird-skins by Mr. Walter Chamberlain; the Scott collection of British birds and foreign Lepidoptera, from Mrs. Adrian Hope and Mrs. Farnham, the Bradley collection of Hymenoptera, Diptera, Lepidoptera, etc., from Mr. A. R. Hollinsworth, the herbarium of British plants from Mr. J. E. Bagnall, a large collection of British and foreign plants from the late Sir Benjamin Stone, the Sir George Kenrick Library of entomological works, the Wilkins' ethnographical works, and numerous miscellaneous collections—a nearly complete collection of British birds (about 1,200 specimens) together with more than 14,000 nests and eggs, and one of the finest series of nestling birds in downy plumage in existence, purchased and presented in 1924 by the Feeney Charitable Trustees, is on exhibition. There is also a collection of British and foreign freshwater and marine shells, formed by the late W. H. Whitlock, and a comprehensive land and freshwater shell collection obtained by the late P. T. Deakin. The scheme for the arrangement of the specimens was drawn up by the late Prof. F. W. Gamble. In addition, weekly nature study exhibits, mainly of a botanical nature, are arranged during the summer months. In 1912, an assistant-keeper for the Natural History Department was appointed.

Award of the Eugenio Rignano Prize

The committee of judges for the award of the Eugenio Rignano prize for the best essay on "The Evolution of the Notion of Time" has recently announced its decision in a "Rapport de la Commission du Jury" dated October 1933. The prize, having a value of 10,000 lire, was established in 1930 as a memorial to E. Rignano, director of *Scientia*, who died in Milan on February 9 of that year. Competing essays were submitted by the end of 1932. No limitations were imposed as to mode of treatment, so that equal scope was afforded to scientific and philosophical aspects of time. A total of 35 essays were submitted, from the following countries: Italy (7), France (6), Germany (6), India (4), Great Britain (2), United States (2), Hungary (2), and one each from Austria, Switzerland, Russia, Luxembourg, South America and Australia. As a preliminary selection of essays of outstanding merit, the committee chose the papers of the following authors: E. Klein, W. Gent, G. Giorgi, H. Mehlberg, K. Sapper, J. Sivadjan, L. von Strauss, G. Windred and S. Zawirski. Of these, Prof. G. Giorgi of the University of Palermo and Prof. S. Zawirski of the University of Poznań were finally selected as *ex aequo* recipients of the prize.

Considerable space is devoted in the "Rapport" to a comparison of the various works submitted, and the widely varying nature of their treatment is remarked upon. The papers of G. Windred and K. Sapper receive extensive discussion in this connexion. Both papers are concerned with the historical development of the subject, but the points of view are respectively scientific and philosophical. The former author confines his attention chiefly to the problem of time as arising in mathematics and physics, tracing the origin and development of the various concepts from the time of Barrow and Newton up to the present day. The treatment of Sapper is essentially philosophical, and mainly concerned with temporal systems such as those developed by Kant and Leibniz, having but few connexions with mathematical or physical theory. These two methods of approach are representative of the widely different points of view of science and philosophy, even upon such a universal concept as that of time.

Recent Advances in Inorganic Chemistry

Lectures, delivered last year before the Institute of Chemistry by Prof. G. T. Morgan, entitled "A Survey of Modern Inorganic Chemistry" have been made available to a wider audience by their publication by the Institute as a pamphlet which extends to more than one hundred pages (London: Institute of Chemistry). The three lectures thus provide chemists with a valuable monograph on the recent advances and tendencies of inorganic chemistry. Prof. Morgan describes, *inter alia*, the discovery and preparation of 'heavy' hydrogen, which some believe will prove so different from ordinary hydrogen as to be regarded almost as a new element, "in which case the organic chemistry of compounds containing this heavy isotopic hydrogen will become a fascinating but fearful study". Mention is made of the newer fundamental units of atomic structure, and attention is given to the electronic conception of chemical valency. The periodic groups of elements are then considered in turn with reference to the experimental successes of recent years in the discovery of new elements, new types of compounds, and new properties. Co-ordination compounds, in view of their general importance and of an interest which has resulted in many contributions to our knowledge of their behaviour having been made by Prof. Morgan and his pupils, receive due examination. The survey in this pamphlet disposes adequately of the suggestion that inorganic chemistry is anything other than a progressive and rapidly growing section of the science, and it is satisfactory that there are evident signs of a renewed interest in this branch of research among British chemists.

North American Earthquakes

Towards the end of January, two violent earthquakes occurred in North America. The first on January 28 at 2.9 p.m. (7.9 p.m., G.M.T.) caused great damage in the Mexican port Acapulco and other towns in Guerrero. From the records at eleven stations, the epicentre is placed by the U.S. Coast and Geodetic Survey in lat. 15° N., long. 99° W. As this point is 140 miles due south of Acapulco, the earthquake must have been of great strength to damage houses in that city. The second occurred on January 30 at 3.16 a.m. (8.16 a.m., G.M.T.). According to the records from seven observatories, the epicentre lay in lat. 38·8° N., long. 118·6° W. This point is in the State of Nevada in the Walker Lake region, and is close to the epicentre of the earthquake of June 25, 1933, and about 50 miles west of that of the great earthquake of December 21, 1932, one of the most violent recorded in the United States (Wire Report, Science Service, Washington, D.C, January 30 and 31).

Pyrex Glass for the 200 in. Reflector

According to a Science Service report, the 200 in. mirror of the new Californian telescope will be made of a sort of pyrex glass and will be poured very shortly. It was at one time proposed to make the mirror of fused quartz, but a superior pyrex glass, which has a small temperature coefficient of expansion, has been developed for the purpose. The glass will be taken from the furnace at a temperature of 1,500° C and poured at about 1,000° C. The cooling and annealing processes will occupy several months The oven for the large reflector has already been used to make a 120 in. flat which will be required to test the larger mirror Preliminary tests for strain have shown that this flat is superior to the excellent 60 in. mirror now used at Mount Wilson. The flat is perfectly clear and almost free from bubbles. The test flat will have the same type of construction as the big mirror, namely, a hexagonal system of ribs, which gives rigidity, and in which nineteen points of support will be provided. Ten supporting levers will be attached in ball bearings so that frictional and elastic distortions will be minimised. The holders will work in any position so that the mirrors can hang upside down if necessary.

Work of International Polar Year Expedition

The Symons memorial lecture of the Royal Meteorological Society will be given on Wednesday, March 21, at 7.30 p.m, by Mr J M. Stagg, leader of the British Expedition which occupied Fort Rae in Canada during the Second International Polar Year, 1932–33. The site of Fort Rae is of exceptional interest, as it lies near the zone of maximum frequency of aurora, and auroral photography was one of the most important objects of the expedition Extensive studies were also made in meteorology, including upper air investigation, atmospheric electricity and terrestrial magnetism. The expedition occupied a site very near to that of the Canadian and British expedition during the first International Polar Year of 1882–83, and thus gave an opportunity for obtaining valuable determinations of secular change of the magnetic elements. Mr. Stagg will also describe some of the practical difficulties and interesting or unusual experiences which the expedition met with. As the lecture this year is of unusual interest, the Council has obtained the use of the hall of the Royal Geographical Society, Kensington Gore. An additional meeting of the Royal Meteorological Society will be held on March 28, at 5.30 p.m., at 49 Cromwell Road, South Kensington, when Prof. W. Schmidt, Director of the Central Meteorological Institute, Vienna, will deliver a lecture on micro-climatological work in Austria.

Announcements

Dr Harlow Shapley, director of Harvard College Observatory and Paine professor of astronomy at Harvard University, will deliver the George Darwin lecture for 1934 at the ordinary meeting of the Royal Astronomical Society on May 11, taking as his subject "Some Structural Features of the Metagalaxy"

At the annual general meeting of the Society of Public Analysts held on March 2, the following officers were elected for the year 1934 —*President*, Mr. John Evans ; *Vice-Presidents*, Messrs. L. Eynon, S. E. Melling, A More, W H Roberts ; *Honorary Treasurer*, Mr. E B Hughes ; *Honorary Secretary*, Mr G Roche Lynch.

At the annual general meeting of the Geological Society of London on February 16, the following officers were elected *President*, Mr J F N Green ; *Vice-Presidents*, Prof P. G H. Boswell, Prof. W. S. Boulton, Sir Thomas Holland and Mr. W Campbell Smith ; *Secretaries*, Prof W T Gordon and Dr. L Hawkes ; *Foreign Secretary*, Sir Arthur Smith Woodward, *Treasurer*, Mr. F N. Ashcroft.

A Conference on "Modern Changes in the Treatment of Light Soils" has been arranged to be held at Rothamsted Experimental Station on March 20, at 11 30 Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden

The Faraday Society has arranged a general discussion on "The Determination and Interpretation of Dipole Moments" to be held at Exeter College, Oxford, on April 12–14, under the presidency of Dr N V Sidgwick. The discussion, which will be introduced by Prof. P. Debye (Leipzig), will be divided into two parts, namely, determination and interpretation Among the foreign visitors who have promised papers are. Dr. A E van Arkel (Eindhoven), Dr. J. L. Snoek (Eindhoven), Dr. E Bretscher (Zurich), Prof. P. Girard (Paris), Dr O Hassel (Oslo), Prof. F Horst Muller (Leipzig), Prof. W H. Rodebush (Illinois), Prof. C P. Smyth (Princeton), and Prof. J. W. Williams (Wisconsin) Further information can be obtained from the Secretary, Faraday Society, 13 South Square, Gray's Inn, London, W C.1.

Applications are invited for the following appointments, on or before the dates mentioned :—Temporary civil engineering assistants for the London County Council—The Chief Engineer (D), County Hall, Westminster Bridge, S.E.1 (March 20). A head of the Department of Mathematics and Physics at the Municipal Technical College, Halifax—The Education Officer, Education Offices, West House, Halifax (March 23). Borough electrical engineer and manager, County Borough of Halifax—Town Clerk, Town Hall, Halifax (March 24). A demonstrator in inorganic and physical chemistry, Bedford College for Women —Secretary (April 21). A head of the Department of Building at Heriot-Watt College, Edinburgh—The Principal (April 23). A lecturer in chemistry, University of Reading—Registrar (May 7).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Transmutation Effects observed with Heavy Hydrogen

WE have been making some experiments in which diplons have been used to bombard preparations such as ammonium chloride (NH_4Cl), ammonium sulphate ($(NH_4)_2SO_4$) *and orthophosphoric acid* (H_3PO_4), *in* which the hydrogen has been displaced in large part by diplogen. When these D compounds are bombarded by an intense beam of protons, no large differences are observed between them and the ordinary hydrogen compounds. When, however, the ions of heavy hydrogen are used, there *is an enormous emission of fast protons* detectable even at energies of 20,000 volts. At 100,000 volts the effects are too large to be followed by our amplifier and oscillograph. The proton group has a definite range of 14.3 cm., corresponding to an energy of emission of 3 million volts. In addition to this, we have observed a short range group of singly charged particles of range about 1.6 cm., in number equal to that of the 14 cm. group. Other weak groups of particles are observed with the different preparations, but so far we have been unable to assign these definitely to primary reactions between diplons.

In addition to the two proton groups, a large number of neutrons has been observed. The maximum energy of these neutrons appears to be about 3 million volts. Rough estimates of the number of neutrons produced suggest that the reaction which produces them is less frequent than that which produces the protons.

While it is too early to draw definite conclusions, we are inclined to interpret the results in the following way. It seems to us suggestive that the diplon does not appear to be broken up by either α-particles or by proton bombardment for energies up to 300,000 volts. It therefore seems very unlikely that the diplon will break up merely in a much less energetic collision with another diplon. It seems more probable that the diplons unite to form a new helium nucleus of mass 4.0272 and 2 charges. This nucleus apparently finds it difficult to get rid of its large surplus energy above that of an ordinary He nucleus of mass 4.0022, but breaks up into two components. One possibility is that it breaks up according to the reaction

$$D_1^2 + D_1^2 \longrightarrow H_1^3 + H_1^1$$

The proton in this case has the range of 14 cm. while the range of 1.6 cm. observed agrees well with that to be expected *from momentum relations for an* H_1^3 particle. The mass of this new hydrogen isotope calculated from mass and energy changes is 3.0151.

Another possible reaction is

$$D_1^2 + D_1^2 \longrightarrow He_2^3 + n_0^1$$

leading to the production of a helium isotope of mass 3 and a neutron. In a previous paper we suggested that a helium isotope of mass 3 is produced as a result of the transmutation of Li^6 under proton bombardment into two doubly charged particles. If this last reaction be correct, the mass of He_2^3 is 3.0165, and using this mass and Chadwick's mass for the neutron, the energy of the neutron comes out to be about 3 million volts. From momentum relations the recoiling He_2^3 particle should have a range of about 5 mm. Owing to many disturbing factors, it is difficult to observe and record particles of such short range, but experiments are in progress to test whether such a group can be detected. While the nuclei of H_1^3 and He_2^3 appear to be stable for the short time required for their detection, the question of their permanence requires further consideration.

M. L. OLIPHANT
P. HARTECK
RUTHERFORD

Cavendish Laboratory,
Cambridge.
March 9.

Magneto-Caloric Effect in Supraconducting Tin

IN connexion with experiments on persistent currents in spheres, and in continuation of previous work on the energy content of supraconductors[1], measurements were carried out on the adiabatic magnetisation and demagnetisation of supraconducting tin.

We used a cylinder of 2 cm. diameter, 5.5 cm. long, with a phosphor-bronze resistance thermometer which was calibrated both with and without a field. The experiments were carried out in the temperature range 2.5°–4.0° K., and both longitudinal and transverse fields were used. The field strength was always considerably higher than the magnetic threshold values of tin.

We observed a cooling effect on magnetisation and a heating effect on demagnetisation. The heating was always greater than the corresponding cooling, as in both cases, when the field was above the threshold value, an additional heating due to eddy currents was produced. Measurements were mainly carried out on the cooling effect, which was found to increase from zero at the normal transition point (3.7° K.) to the lowest temperatures reached. The effect appeared to be the same for longitudinal and transverse fields within the limits of experimental error.

The cooling observed at the various initial temperature indicated was 0.05° at 3.3° K., 0.11° at 3.0° K., 0.21° at 2.7° K., 0.33° at 2.5° K. Still greater cooling could be obtained by using a magnetic field exactly equal to the magnetic threshold value corresponding to that temperature, as this would eliminate the heating effect of eddy currents.

The theoretical discussion of these results and their connexion with recent calculations by C. J. Gorter and others may be postponed until further experimental material is available.

Experiments are being carried out to investigate this cooling effect at lower temperatures and with different substances. It will perhaps be possible to use the adiabatic magnetisation of supraconductors as a simple method (as the fields necessary are small) of producing very low temperatures.

K. MENDELSSOHN
J. R. MOORE

Clarendon Laboratory,
Oxford.
Feb. 17.

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[1] *Z. phys. Chem.*, B, 16, 72, 1932.

Kinetics of Photosynthesis and Allied Processes

THE photosynthetic process in the living plant consists of two separate reactions, namely, the primary photosynthetic reaction which has no temperature coefficient, and the dark or Blackman reaction which restores the conditions disturbed by the primary reaction and has a temperature coefficient The velocity of the primary reaction is proportional to the concentration of the chlorophyll on the irradiated surface, the intensity of light and the concentration of the hydrated carbon dioxide If these factors be denoted by a, I and P, respectively, the initial velocity will be expressed by k_1aIP, and the velocity at time t will be $k_1IP(a - x)$ The dark reaction is known to be unimolecular, and its velocity at time t will be $k_2xe^{-Q/RT}$. It is obvious that a photostationary state will be established when the velocities of the primary and Blackman reactions become equal, and if this state be established at time t, then the observed rate of photosynthesis will be given by

$$y = k_1IP(a - x) = k_2xe^{-Q/RT} \qquad (1)$$

Dividing by k_1IPx we have

$$\frac{y}{k_1IPx} = \frac{a-x}{x} = \frac{k_2}{k_1IP}e^{-Q/RT}$$

But $k_1IPx = k_1IPa - y$, where k_1IPa is the initial rate of photosynthesis, and for any one set of conditions is a constant, and if this be denoted by K we have

$$\log\frac{y}{K-y} = \log\frac{k_2}{k_1IP} - \frac{Q^1}{T}, \qquad (2)$$

where $Q^1 = Q/2\ 303\ R$

This formula expresses with great accuracy Emerson's four series of observations of the variation with temperature in the rate of photosynthesis with *Chlorella*[1] The value of K, as indicated by the formula, decreases with the chlorophyll concentration, and the four values of Q are 30,105, 29,309, 29,959, 29,905 calories, respectively, with a mean value of 29,819 calories

The formula also explains the fact, first discovered by Blackman and more recently observed by Warburg[2], that the temperature coefficient becomes unity when the intensity of light is small

By the elimination of x from (1) we obtain

$$y = \frac{k_1IP\,a\,k_2e^{-Q/RT}}{k_1IP + k_2e^{-Q/RT}} \qquad (3)$$

from which may be derived

$$\frac{I}{y} = \frac{1}{k_1aP} + \frac{I}{ak_2e^{-Q/RT}} \text{ and } \frac{P}{y} = \frac{1}{k_1aI} + \frac{P}{ak_2e^{-Q/RT}} \qquad (4)$$

These equations indicate linear relations between I/y and I, and between P/y and P, when the temperature is constant Warburg's observations[2] of the relations between the rate of photosynthesis and the intensity of light and the hydrated CO_2 concentration, respectively, at constant temperature are expressed by the above linear equations.

Let the case be postulated of heterogeneous catalysis in which the primary catalytic reaction is effected by the de-activation of the catalyst, and the de-activated catalyst is re-activated by a thermal reaction. If a be the initial concentration of the active catalyst, c the concentration of the catalyte, and d the concentration of the substance which re-activates the catalyst, then, if c and d be large and sensibly constant, equation (2) becomes

$$\log\frac{y}{K-y} = \log\frac{k_2d}{k_1c} - \frac{Q^1}{T},$$

where $K = k_1ac$ and y is the observed rate of catalysis. Equation (3) now becomes

$$y = \frac{k_1ack_2de^{-Q/RT}}{k_1ac + k_2de^{-Q/RT}} \qquad (5)$$

whence we have

$$\frac{c}{y} = \frac{1}{k_1a} + \frac{c}{k_2de^{-Q/RT}}$$

which indicates a linear relation between c/y and c when d and T are constant. Under these conditions, equation (5) may be written in the form

$$y = \frac{k^1ac}{c + K_m}$$

which is the well-known Michaelis equation for enzyme action when a and c are the concentrations of enzyme and substrate, respectively The wide applicability of the Michaelis equation and the close analogy between it and the equations expressing the rate of photosynthesis suggest that enzyme action is also a cyclic process, in which the primary catalytic reaction is effected by the de-activation of the enzyme, and the de-activated enzyme is re activated in a thermal reaction, possibly by the co-enzyme.

E C C BALY
L B. MORGAN.

The University,
Liverpool.

[1] *J. Gen. Physiol.*, 12, 623, 1929.

[2] *Biochem. Z.*, 100, 258, 1919

Formation of Vortex Rings from a Liquid Drop

A DROP of liquid heavier than water, for example blue or red ink, submerged quietly into still water, encounters the resistance of the medium and becomes flatter in its form in the course of its descending motion The central part of the disc thus formed soon disappears, and consequently a ring form results.

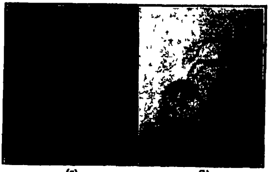
(a) (b)

FIG. 1.

This is a very slowly whirling vortex ring. As it proceeds, the radius of the ring is augmented, and it begins to disintegrate into several minor vortex rings Each of the secondary vortex rings proceeds in the same manner as the primary one, and disintegrates as well. The process of disintegration may be continued so far as the material remains ample.

This phenomenon has been described by Fr Ahlborn and shown diagrammatically[1]. I also studied this process of disintegration a few years ago, and several photographs were taken Those photographs were not published, and the matter has been forgotten. Ahlborn's description is, however, diagrammatic and not photographic · those photographs of mine, I think, might have some scientific interest. Two of them are reproduced here (Fig 1) (*a*) is one of the most beautiful examples, and represents the first disintegration stage and the beginning of the second disintegration (*b*) shows a further developed stage, but not a continuation of (*a*).

S. YAJIMA

Imperial University of Tokyo
Jan 18.

[1] "Dynamik des Regens", *Phys Z*, 32, 139, 1931.

Scattering of Hard Gamma Rays by Lead, and the Annihilation of Positive Electrons

THE following experiment was carried out to make a further test of the hypothesis, proposed by Blackett and Occhialini, that the 'nuclear' scattering of hard γ-rays by heavy elements is due to the annihilation of positive electrons produced by the γ-rays[1]. γ-rays from an emanation tube were used, the source being placed at *S* (Fig 1). Observations were made on the ionisation produced in the chamber *I* due to the introduction of a thin lead foil (0 1 mm) into the position *BB'*, first, *with* an aluminium sheet (3 mm thick) at *AA'*, secondly *without* the aluminium sheet According to the above hypothesis, the ionisation should be greater in the first case, because the positive electrons which are produced in the lead foil and escape from it in the forward direction, are stopped in the aluminium sheet In the second case they are practically lost from the neighbourhood of the ionisation chamber, and therefore also their annihilation radiation. Apart from this, the only difference between the two cases is that, in the first, the lead foil absorbs some of the radiation scattered by the aluminium This tends to make its effect smaller than in the second case, and is therefore in the *opposite* direction to the above positive electron effect. Quantitatively, the absorption effect is, however, quite small, being only 2 per cent of the total effect of the lead foil.

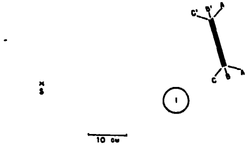

FIG 1

The results of several observations showed that the effect of the lead foil was greater when the aluminium sheet was present than when it was away, the difference being 25±3 per cent. The result provides direct evidence for the positive electron hypothesis. Quantitatively it is difficult to say whether the fraction 25 per cent is consistent with the supposition that *all* the 'nuclear' radiation from lead is due to the agency of positive electrons Two factors detract from a 100 per cent effect In the first place, a certain fraction of the positive electrons produced in the foil will not be able to escape from it in the forward direction, owing to insufficient range and to scattering in the foil Secondly, the wax sheet placed at *CC'* (which absorbs in all cases the positive electrons escaping backwards from the foil) is also a source of positive electrons, and the stopping of these by the lead foil further reduces the effective number which escapes from it

Accurate analysis is difficult, and to find, by this method, if some of the 'nuclear' radiation from lead consists of other radiation than that associated with positive electrons, observations with different thicknesses of foil and different degrees of filtering must be made The above observations were made with 1 cm lead filter in the path of the scattered rays. This was sufficient to absorb the Compton radiation, the angle of scattering being about 140°

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Jan 22

[1] Since the present results were obtained, papers by Joliot and Thibaud (*Comptes rendus*, Dec 18, 1933) have appeared, which also report direct evidence for the annihilation of positive electrons, a magnetic field being used to deflect positive electrons so as to be stopped close to an ionisation chamber

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Determination of Dipole Moments in Solution

SUBSTANCES the molecules of which contain a large permanent dipole give a marked decrease in the measured values of the molecular polarisation P_2 in solution as the concentration of the solution increases This effect has been ascribed to dipole association , it appears to be much too large to be due to association in the chemical sense of the term since, for example, nitrobenzene, which from many of its physical properties would be classed as a nearly normal liquid, shows a considerable fall in P_2 in benzene over the concentration range 0 5–2 per cent.

If P_2 is plotted against the volume polarisability $(\epsilon - 1)/(\epsilon + 2)$ for solutions of benzonitrile, nitrobenzene and chlorobenzene in a number of non-polar solvents, the points for each substance all lie near a straight line through the entire range of solutions to the pure liquid (Fig 1) The values of ∞P_2 found by Horst Muller for chlorobenzene and those recently given by Jenkins for nitrobenzene all lie close to the appropriate curve

This regularity appears to apply only to solutions in solvents with small or zero moments Thus solutions of benzonitrile in chlorobenzene measured by me give points which lie well below the line in Fig 1 Highly associated liquids, for example alcohols, may also be expected to deviate from the linear law

A crude picture of the phenomenon underlying the relationship shown in Fig 1 may perhaps be drawn as follows. The permanent dipole of a molecule in a solution may be regarded as surrounded by an 'atmosphere' of dipoles of opposite sign produced partly by induction in the polarisable solvent molecules and partly by orientation of adjacent permanent dipoles The measured polarisation therefore appears to be less than the true value The correction for the opposing atmosphere of dipoles should be a function of the volume polarisability of the solution, and the true value of P_2 should be obtained by extrapolating the curve to $(\epsilon - 1)/(\epsilon + 2) = 0$. It is clear from the large slopes of the curves for benzonitrile and nitrobenzene that the value for $_\infty P_2$ in any solvent will be lower than the extrapolated value since even for hexane $(\epsilon - 1)/(\epsilon + 2) = 0·228$

The other end of the curve also appears to be of interest When $(\epsilon - 1)/(\epsilon + 2)$ becomes unity

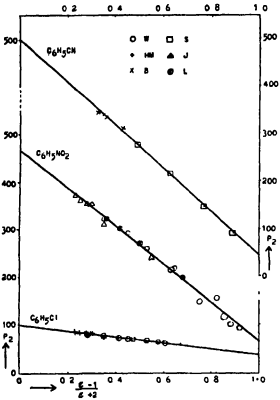

FIG 1 Relation of volume polarisability to molecular polarisation

W Williams and Ogg, *J Amer Chem Soc*, 50, 94, 1928
HM Horst Müller, *Phys Z*, 33, 732, 1932
B Bergmann *et al*, *Z physikal Chem*, B, 10, 397, 1930
S · Sugden, unpublished data
J Jenkins, NATURE, 133, 106, Jan 20, 1934
L Lange, *Z phys*, 33, 169, 1925

$(\epsilon = \infty)$ the atmosphere of dipoles should neutralise the permanent dipole and only the distortion terms $P_A + P_E$ should be effective. If the curve is linear, its slope should then give $P\mu$, if it has a more complicated form, then the difference between the extrapolated values of P_2 for zero and unit volume polarisability should give $P\mu$. From the data in Fig 1, the best line through the observed points (calculated by the method of zero sum) gives the following values of μ in the usual units. benzonitrile 4·7, nitrobenzene 4·4, chlorobenzene 1·7 In benzene solution the first two substances give lower moments, 3·9 and 4·1 respectively, whilst chlorobenzene gives 1·52.

There are no data available in the literature for the dipole moments of these substances in the vapour state. Mr L G. Groves and I have recently measured the dielectric constants of the vapours of these and other substances with a high dipole moment and find for benzonitrile $\mu = 4·3$, and for nitrobenzene, $\mu = 4·4$ These results are of a preliminary character and may be modified by further work, they seem, however, to confirm the view that dipole moments calculated from $_\infty P_2$ in a solvent may be seriously in error when the dipole moment is large.

S. SUGDEN

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Feb 5

Predissociation in the First Positive Group of Nitrogen

THE electronic level diagram of the normal N_2 molecule is shown in Fig 1. The horizontal full lines represent the different electronic levels, the dotted lines the dissociation states, known transitions between the different molecular levels are represented by vertical arrows, whereas the electronic levels are connected by brackets with the atomic states into which they dissociate. As the position of the singlet levels relatively to the triplet ones is still rather uncertain, the zero of the scale of volts has been put at the triplet level $A^3\Sigma$ The dissociation states of the different molecular levels have already been given by various workers, of whom especially J Kaplan must be named[1] By his observation of the predissociation in the $B^3\Pi$-level of the first positive group (transition $B^3\Pi \rightarrow A^3\Sigma$) at

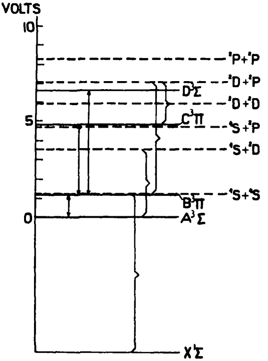

FIG 1.

$v' = 12$ and $v' = 20$, he was able to give strong evidence in favour of the diagram. Predissociation in the $C^3\Pi$-level was first observed by G. Herzberg[2] and studied in detail by D Coster, F. Brons and A v. d Ziel[3]. They interpreted this predissociation as due to the $^2D + {}^2D$ dissociation state, as was also done by Kaplan.

I am now able to bring forward new and strong evidence in favour of the diagram given above from a detailed investigation of the 12 → 8 transition of the first positive group ($B^3\Pi \rightarrow A^3\Sigma$) in which according to Kaplan the predissociation should occur. In this investigation, the work done by Naudé[4] on the $5 \rightarrow 2$ and $6 \rightarrow 3$ transitions of the same band system was of great value. Naudé has pointed out that the structure of the first positive group agrees with a $^3\Pi \rightarrow {}^3\Sigma$ transition. Twenty-seven branches are to be expected, nine strong branches and eighteen weaker branches. If the $B^3\Pi$ state were in Hund's case *b*, only the nine strong branches should occur. But the $B^3\Pi$ state is in case *a* for the lower J values and proceeds to case *b* for higher J values. A rotational analysis of the $12 \rightarrow 8$ band showed that the band lines suddenly become much less intense. This happens at $J = 32$ for the $^3\Pi_2$ level, $J = 33$ for $^3\Pi_1$ and $J = 34$ for $^3\Pi_0$, and in the R and P branches at the same place as in the Q branches.

This cannot be explained by assuming that the state causing this predissociation is $^4S + {}^4S$. This level gives rise only to Σ-states. Σ-states are in Hund's coupling case *b*. For such high rotational levels we are certainly also for the Π-states nearly in case *b*. Each one of the three Σ-states forming a triplet perturbs only one of the Π triplet states. These Π-triplets are double because of the Λ-doubling; Σ-states are not. Therefore only one of these Λ-doubling components of the Π states should predissociate, whereas on the contrary I observed the predissociation in both the Λ-doubling components (P- and R- as well as Q-branches predissociate). We thus may conclude that the perturbing level in this case is certainly not $^4S + {}^4S$ but that it may be $^4S + {}^2D$, as was formerly assumed.

A. VAN DER ZIEL.

Natuurkundig Laboratorium
der Rijks-Universiteit,
Groningen.
Jan. 10.

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[1] *Phys. Rev.*, **37**, 1406; 1931. **38**, 1079; 1931. **41**, 114; 1932.
[2] *Ergebn. exakt. Naturwiss.*, **10**, 207; 1931.
[3] *Z. Phys.*, **84**, 304; 1933.
[4] *Proc. Roy. Soc.* A, **138**, 114; 1932.

The 'Manatee' of St. Helena

In my paper "On the 'Manatee' of St. Helena"[1] I brought forward evidence that the so-called 'manatee' formerly found at St. Helena was a sea-lion, probably the Cape sea lion, *Arctocephalus antarcticus*, not a sea-cow, natural conditions at St. Helena being quite unsuitable for sea cows.

Sir Charles Harper, formerly Governor of St. Helena, to whom I sent a copy of my paper, has very kindly directed my attention to a passage in Dampier's "Voyages" (ed. by Masefield, publ. by Grant Richards, London, 1906), which has a very important bearing on this question.

Dampier, who visited St. Helena in June 1691, also mentions the 'manatee', stating: "I was also informed that they get Manatee or Sea Cows here, which seemed very strange to me. Therefore inquiring more strictly into the matter, I found the Santa Hellena Manatee to be, by their shapes, and manner of lying ashore on the Rocks, those Creatures called Sea-lyons; for the Manatee never come ashore, neither are they found near any rocky Shores, as this Island is, there being no feeding for them in such places. Besides, in this Island there is no River for them to drink at, tho' there is a small Brook runs into the Sea, out of the Valley by the Fort" (I, p. 526).

Dampier gives (I, p. 64–67) an excellent description of the manatees and their mode of life from his own observations in the West Indies, the Philippines and Australia. Thus he knows what he is speaking about. His direct statement concords with the result reached indirectly through my own observations. The evidence is accordingly now conclusive that the much discussed St. Helena 'manatee' is a sea-lion, and the conclusions in regard to former land connexions drawn from the existence of the 'manatee' at St. Helena are without foundation.

TH. MORTENSEN.

Zoological Museum,
Copenhagen.
Feb. 18.

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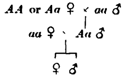
[1] *Vidensk. Medd. Dansk Naturhist. Forening*, **97**; 1933.

Possibility of Incomplete Sex Linkage in Mammals

In a paper shortly to be published, Koller and Darlington find that, in the first meiotic division of *Rattus norvegicus* males, one or two chiasmata are formed between the X- and Y chromosomes. If chiasma formation corresponds with the crossing-over of genes, it follows that where the chiasma lies between the locus of a gene and the region in which X- and Y chromosomes differ, such a gene will exhibit crossing over with sex. On the basis of the cytological observations, genes in a certain region of the chromosome should show about 5 per cent crossing-over with sex, in another about 45 per cent. These latter genes would behave in very nearly the same manner as autosomal genes. It thus follows that some genes regarded as autosomal may in reality be incompletely sex-linked. Such linkage would show up in a pedigree of the following type:



The progeny in the third generation would be in the proportions

55 *Aa* ♀ 45 *aa* ♀ 45 *Aa* ♂ 55 *aa* ♂

in a case involving 45 per cent crossing over. A glance through the literature shows that data must be available which would enable this hypothesis to be tested, but that they have not been published since the progeny of such matings are not usually classified for sex.

We wish to appeal to authors to give data in future communications which will enable the above hypothesis to be tested, and, where possible, to examine for partial sex linkage the data on which former publications have been based. It is most likely that such cases would be found in mammals, including man, where the Y chromosome is often fairly large as compared with the X-chromosomes, but they are perhaps also possible, *mutatis mutandis*, in birds and other groups.

C. D. DARLINGTON.
J. B. S. HALDANE.
P. CH. KOLLER.

John Innes Horticultural Institution,
London, S.W.19. Feb. 28.

The Floating Barnacle on the North Cornish Coast in the Summer of 1933

THE occurrence of the pelagic and planktonic floating barnacle, *Lepas fascicularis*, on the shore at New Train Bay, Trevone, near Padstow, Cornwall, in the summer of 1933, is an event sufficiently rare to be worthy of record along with other unusual marine events of that outstanding year

About fifty individuals (with capitula 13–32 mm in length) were taken alive on August 22 at about the time of high water (a m) at the beginning of a set of spring tides and within an hour or so of being stranded, some yielding living larvæ later. No others were found in the locality in the following week even after careful searching In water most of them floated freely by means of their spherical peduncular secretion (diameter 11–20 mm) containing gas-bubbles and vesicles, either singly, or in groups of two to five with their floating apparatus fused into one spherical mass (see Fig 1). Two small ones with capitula 21 mm and 22 mm were attached—along with the tropical barnacle, *L pectinata*—to floating fronds of *Fucus*, or to cinders, solely by means of a small flattened adherent expansion of the peduncle (thus confirming Ellis's original figure made in 1786), whereas others smaller and unattached (with capitula 14–20 mm) had well-developed floats Some of the larger individuals were attached to floating fronds of the seaweeds, *Fucus* and *Ascophyllum*, by extensions of the spherical float in such a way as to suggest that this organ may be adhesive and capable of expanding secondarily around a strange object, but simple experiments made under conditions normal for the species are required for further information Darwin[1] has shown that the larval peduncle is always attached to some floating object, around which the float is formed later, presumably—we suggest—when the animal develops a tendency to sink and perhaps in response to increased pressure.

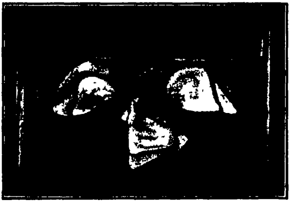


FIG. 1 A group of four barnacles, *L fascicularis*, attached by short stalks to the common float seen in the centre The group is photographed floating but held slightly submerged × about $\frac{7}{10}$ (Photo P Bond)

At various times the barnacles have been recorded as attached to a great variety of flotsam and jetsam, but the mode of attachment is rarely given. It would seem that a secondary attachment of the float would give a single animal greater mechanical efficiency in its feeding stroke, as no energy is required for or dissipated in maintaining a stable system; two animals on opposite sides of a free float with a body-beat synchronised would, however, appear to give efficiency. In this regard it may be that the special form of the keel plate is correlated with modified muscular requirements in a floating habit of life

This peculiar barnacle occurs in the open ocean and is recorded from all temperate and tropical waters[2], whence it is said to be blown ashore in various parts of the world by persistent winds. Damas[3], however, has shown that it is carried normally into the Norwegian seas from the Atlantic along with other Atlantic plankton at about mid summer In a similar way Schmidt followed the gradual extension of the planktonic *Salpa* from the North Atlantic into the North Sea in 1905[3] In some years, therefore, Atlantic plankton may be carried in the invading summer water, apparently independently of wind drift, into the North Sea, and there is evidence for a similar invasion of Atlantic water into the English Channel[4]. Whether the presence of the floating barnacle on the Cornish coast is an indication of an unusual offset of Atlantic water along the Cornish coast in the summer of 1933, or to a prevalent set of westerly winds, may perhaps be revealed later by hydrological observations.

Since 1786 only seven or eight records appear to have been made of the occurrence of *L. fascicularis* on the south coasts of England, and the same number for the west and north of Ireland[1,5,6] It has been found on the Northumberland coast on three occasions in the period between 1857 and 1894[7] In the latter cases the barnacles would appear to have followed the route of *Salpa* mentioned above from the Atlantic and have been afterwards blown ashore; they are not infrequently found in the North Sea[10]

L pectinata has been recorded only about five times since 1803 from the coasts of the British Isles[1,8,9]

It would seem that the interesting floating barnacle may often serve as a useful indicator of important physical events, and is therefore worthy of being more widely known

J. H. ORTON.
RUTH RAWLINSON

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Jan 18

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[1] Darwin, "Monograph of the Cirripedes Lepadidæ", 1851
[2] Gruvel, "Monographie des Cirrhipèdes ou Thécostracés", 1905
[3] Murray and Hjort, "Depths of the Ocean", pp 711 and 710, 1912
[4] Matthews, Int Fish Invest Mar Biol. Assoc, Cmd 4641, 1909.
[5] Vallentin, *J Roy Inst Cornwall*, **55**, 1907.
[6] Nichols, *Irish Nat*, **24**, 10, 1915
[7] Norman and Brady, *Trans Nat Hist Soc Northumb*, *Durh and Newcastle*, N S, **3**, 2, 1909
[8] Cocks, Ann Rep Cornwall Poly Soc, 1849–50.
[9] Pilsbury, *Bull U S Mus*, **60**, 1907
[10] Schapor, *Wiss Meeres*, *Kiel*, **19**, 1919–22

Travel of a Pulse of Stress in a Steel Wire

A BRIGHT drawn steel wire ½ in. diameter and 459 ft. long was arranged with one end lying in a solenoid which was excited with direct current. This end of the wire passed through a search coil placed near the central part of the solenoid, the search coil being connected through a valve set to an oscillograph The other end of the wire was firmly clamped When the clamped end was struck a sharp blow a pulse of stress was started and travelled along the wire with the speed of sound On reaching the search coil the changes of permeability of the wire due to the changes of stress gave rise to an E.M.F. which was recorded by the oscillograph. This pulse of stress was reflected from the end of the wire near the search coil and travelled back to the clamped end, was again reflected and once more reached the search coil end and again developed an E.M.F. which was recorded by the oscillograph. An inspection of the oscillogram (Fig. 1) shows that, in addition to the original pulse of stress which has travelled the full length of the wire before reaching the search coil, three successive reappearances of this pulse can be detected, each pulse being due to the reflection of the previous pulse at the clamped end of the wire.

The distance on the oscillogram between two successive records of the E.M.F. is a measure of the time taken for the pulse to travel twice the total length of the wire. The speed at which the pulse travels has been found in this way to be given by

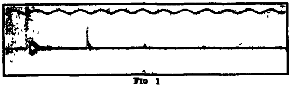

FIG. 1

$c = 5.04 \times 10^5$ cm. per second; or since $E = c^2\rho$, it follows that $E = 1.99 \times 10^{12}$ dynes per sq. cm., or, 29×10^6 lb. per sq. in.

The rate of decay of the amplitude of the pulse due to its passage to and fro along the wire is a measure of the damping.

One purpose of the investigation is to examine the influence of work hardening on this rate of decay, and thus to find out whether the effect can be used as a practical method for the detection of work hardening in the wires of wire ropes.

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Feb. 10.

Chemistry of the Brown Algæ

OUR attention has been directed to a recent paper by Bergmann and Johnson[1] in which they describe the isolation of a sterol, m.p. 126-127°, from *Microciona Prolifera*, a deep red sponge from Long Island Sound. According to these authors, the sterol is a singly unsaturated compound of formula $C_{27}H_{46}O$, different in properties from either spongosterol isolated by Henze[2] or from clionasterol, described by Dorée[3].

We are at present engaged on a detailed survey of the marine brown algæ, and during the course of this work have isolated both from *Fucus vesiculosus* and *Pelvetia canaliculata* a sterol different in properties from the above mentioned sterols for which we propose the name 'fucosterol'.

Fucosterol melts at 124° (*acetate* m.p. 119°, *propionate* m.p. 104°) and gives analyses in good agreement with either a formula, $C_{29}H_{48}O$ or $C_{30}H_{50}O$. The presence of two ethenoid linkages in the molecule has been demonstrated by bromine absorption, perbenzoic acid titration and quantitative catalytic hydrogenation. A detailed account of the chemistry of this new sterol will be published elsewhere.

I. M. HEILBRON.
R. F. PHIPERS.
H. R. WRIGHT.

Victoria University,
Manchester.
Feb. 28.

[1] *Z. physiol. Chem.*, 222, 220; 1933.
[2] *Z. physiol. Chem.*, 41, 109; 1903; *ibid.*, 55, 427; 1908.
[3] *Biochem. J.*, 4, 92; 1909.

Cosmic Rays under 600 Metres of Water

IN October 1933, further work was done to investigate the hardest cosmic rays first found in the salt-mine of Stassfurt (Berlepschschacht der Preussischen Bergwerks- und Hutten A.-G.)[1,2]. The new observations were made in the same manner, and at the same levels, as in July, that is, under 500 m. and 1,000 m. of water; but this time they were extended to the second level (600 m. of water) and with two sets of double counter coincidence apparatuses operating simultaneously. They showed conclusively that these hardest cosmic rays penetrate also to 600 m. of water, as already expected from the 500 m. level measurements[1] and the earlier ionisation chamber observations[2]. From the July experiments[3] the apparent mass absorption coefficient $(\mu/\rho)_{H_2O}$ was deduced as being less than 5×10^{-5} cm.^{2} gm.$^{-1}$ if the penetrating power can be characterised by such a figure, which is of small value as compared with distinct specification of the absorbing screens penetrated.

The new measurements in the 500 m. and 600 m. levels confirm this coefficient as being less than 5×10^{-5} cm.^{2} gm.$^{-1}$ and show the upper limit to be 1.8×10^{-5} cm.^{2} gm.$^{-1}$. Full details of this, and of the other investigations such as the 'law of straight line', 'ω-effect' and directional distribution of these hardest rays, will be given elsewhere.

It is very interesting that Corlin[4], performing ionisation chamber observations in the iron ore mine Kiirunavaara near Kiruna (Northern Sweden) in a manner similar to that which I used in 1928 in Stassfurt, now deduces from his measurements at a depth of 52–86 m. of iron ore (215–430 m. of water) the existence of such hard rays with $(\mu/\rho)_{H_2O} = 1.1 \times 10^{-5}$ and 3×10^{-5} cm.^{2} gm.$^{-1}$.

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Höhenstrahlungslaboratorium des
Meteorologisch-Magnetischen Observatoriums,
Potsdam.
Jan. 20.

[1] W. Kolhörster, *Berl. Ber.*, 23, 689; 1933.
[2] W. Kolhörster, *Ber. Preuss. Met. Institut*, 1931, p. 34; Berlin, 1932.
[3] W. Kolhörster, NATURE, 132, 407, Sept. 9, 1933.
[4] A. Corlin, NATURE, 133, 63, Jan. 13, 1934.

A New Hard Component of the Cosmic Ultra-Radiation

PROF. KOLHÖRSTER has kindly directed my attention to a possible misunderstanding of the statement "a hitherto unknown component" in my communication entitled "A New Hard Component of the Cosmic Ultra-Radiation"[1]. This statement, which referred to the harder Kiirunavaara component, was not intended in any way to dispute Kolhörster's earlier discovery of a very hard radiation capable of penetrating more than 500 m. of water. I had, however, overlooked that Kolhörster has also mentioned[2] a small decrease of the ionisation even down to 700 m. of water found by him so early as 1928 in the Stassfurt mines; it is evident that the whole radiation found by him should not be identified with the softer Kiirunavaara component alone.

AXEL CORLIN.

Observatory, Lund.
Feb. 1.

[1] NATURE, 133, 63, Jan. 13, 1934.
[2] *Berlin Ber.*, No. 23, July 13, 1933.

Research Items

Maize in China. In the annual report of the Librarian of Congress for 1933 (Washington, D.C.) Dr. Walter T. Swingle of the United States Department of Agriculture comments in the report of the Division of Orientalia on certain acquisitions in Chinese literature which refer to maize and other natural products. What would appear to be the earliest reference to maize in China is found in a work entitled *Liu ch'ing jih-cha* by T'ien I-hêng, who was born in 1524. The title of the work literally translated is "Preserved Green Daily [notation] Tablets", it being so called from the fact that it consisted of notes which had been scratched on the leaves of a bamboo grove by the author in his daily walks and meditations. Maize is here described in detail. It is called *yü mai* (Imperial grain) and is said to have come in through *Hsi fan*, literally the western barbarian region, a term which often was used to mean Tibet. Its old name is said to have been *fan mai*, literally barbarian wheat. It is thus clear that maize had been cultivated for some time before the publication of this work in 1573. Three further references to maize occur in Chinese literature between 1573 and 1590, of which at least one was copied from T'ien I-hêng's account. Wang Shih mou in 1587 gives a different name for it and says it was boiled and eaten. These accounts make it clear that within eighty years of the discovery of America by Columbus, maize had reached China. As the records are unanimous that it came from the west, Dr. Swingle suggests that it was not introduced by the Portuguese through Goa as is usually thought, but by the Arabs, who carried it from Spain to Mecca, whence Moslem travellers would have brought it to China through Central Asia. Tobacco, on the other hand, it would appear from a reference in another work, was not planted in China until the third decade of the seventeenth century.

Incubation of Mound-builders. Three papers in the *Victorian Naturalist* (50, Jan. 1934) discuss the habits of the mallee fowl or lowan (*Leipoa ocellata*), the most southern representative of the mound builders. Each mound is the work of a single female, and although in confinement as many as 29 eggs have been laid, in natural conditions 20 or fewer is the rule. The old ideas that the mounds were placed in water-tracks and that the eggs developed because of heat generated by the fermentation of leaves in the mound, must be given up; the mounds are dry and largely composed of loose soil, and development is due to sun heat. The purpose of such vegetation and sticks as are included in the mound is believed to be the prevention of the packing of the soil which would check access of heat and air. But the parent birds assist the process of incubation by scratching away and then replacing the sand on the top and about the rim of the mound, so that during the day the sun's rays may penetrate to the eggs, and that freshly warmed layers of sand may be piled upon the eggs to keep up the temperature during the night. The young when hatched are thus able to find their way to the surface through the loose soil, although when Mr. L. G. Chandler had the good fortune to see a chick emerge at the surface, it appeared at the spot where the old bird had been scratching. The writers differ in opinion about the future of the mallee fowl; one regards it as "doomed to extinction", because of interference with it and its habitat, another says "the extensive range of this most interesting species is my reason for stating that there is no need yet to say that it will soon be extinct".

Extent of the Retention of Ingested Aluminium. In a recent research report, one of a series on the hygienic aspects of aluminium cooking utensils issued by the Mellon Institute of Industrial Research, Pittsburgh, Pa., Messrs. Schwartze, Cox, Unangst, Murphy, and Wigman deal with the extent to which aluminium is stored in the tissues under conditions of a varied alimentary supply of soluble aluminium salts (*J. Amer. Med. Assoc.*, 101, 1933, p. 1722). Experiments were performed on guinea pigs, and the aluminium content of fresh tissues of animals receiving no added aluminium was found to be about 0.4 part per million. Feeding with large amounts of soluble aluminium salts produces a barely detectable deposition of aluminium—less than 0.5 per million in the soft tissues, and 0.5–1 part per million in the whole carcass. No ill effects were observed as a result of these feeding experiments, which in some cases were continued for 570 days, and it is concluded that no harmful effects are likely to occur from soluble aluminium naturally present in foods or introduced by utensils into a diet having a normal phosphorus content.

Plant Disease and Manurial Treatment. A definite correlation between the incidence of a plant disease and the type of manurial treatment applied is not of frequent occurrence, but it appears to be the case with a wilt, *Fusarium vasinfectum*, Atk., of the pigeon pea, *Cajanus indicus*, Spreng. This plant, commonly known as *rahar* in northern India, is included in the crop rotation grown on the permanent manurial plots at the agricultural farm at Pusa. W. McRae and F. J. F. Shaw have made a statistical study of the incidence of wilt on these and a number of other plots at the farm, and their results are published as Scientific Monograph No. 7, issued by the Imperial Council of Agricultural Research, Delhi. The disease was found to cause an average loss of 10 per cent of the plants, but neither the moisture content nor the hydrogen ion concentration of the soil was found to be the controlling factor. Manuring with superphosphate or with cattle manure, on the other hand, resulted in an increase in wilt, whereas green manuring (*Crotalaria juncea*) had the reverse effect and reduced the disease. A combination of superphosphate and green manure, however, brought about an increase in the number of plants affected. Several types resistant to this disease have been isolated, the factor for resistance showing no correlation with any of the morphological characters studied. An interesting feature in this breeding work was the discovery that resistance was lost in a field which had been under *rahar* for a number of years. Such a loss, however, was not transmitted to the next generation, only the soma of the plant being affected.

Estimation of Fungus Disease Intensity. A very interesting report of a "Symposium and Discussion on the Measurement of Disease Intensity" appears in

Part 2, vol 18 of the *Transactions of the British Mycological Society* (pp 174–186, Nov 1933) Three papers on the problems of measurement of intensity of particular diseases were delivered by Messrs A. Beaumont, R W Marsh and H B Bescoby, whilst a section on statistics was contributed by Dr A R Clapham Prof. W. B Brierley opened the discussion, and pointed out that there is usually no correlation between the intensity of disease in the plant and its extent in the crop Mr W Buddin outlined the difficulties of estimating disease intensity encountered by an advisory officer, and suggested that such estimation was only possible for purposes of research. Mr M H Moore showed how different methods of estimating disease intensity gave varying results of spraying trials

Minerals of Clay and Bauxite A statistical study of clay and bauxitic minerals has recently been published by S I Tomkeieff (*Min Mag* , 463 482 , 1933) which leads to a classification of these minerals on a purely chemical basis All the available analyses are plotted on two triangular diagrams and frequency curves are constructed for certain cardinal ratios, such as H_2O Al_2O_3 The suggestion is offered that among substances that have been claimed as minerals only a few can be regarded as definite species, and that the others are probably mixtures of the latter, or their hydration products, or colloids of variable composition The distinct crystalline minerals recognised are

pyrophyllite	H_2O	Al_2O_3	$4SiO_2$
kaolinite and its isomers	$2H_2O$	Al_2O_3	$2SiO_2$
diaspore	H_2O	Al_2O_3	
gibbsite .	$3H_2O$	Al_2O_3	

Probable species, of which, however, the statistical evidence is not clear, include termierite, anauxite and allophane

Study of Winds in the United States Supplement No 35 to the *Monthly Weather Review*, dated November 13, 1933, contains a great mass of statistical information of the kind that is apt to be very unpalatable to the ordinary student of meteorology, but is of value to aviators The work, which is by Loyd A Stevens, of the Aerological Division of the Washington Weather Bureau, is entitled "Upper-Air Wind Roses and Resultant Winds for the Eastern Section of the United States" The information was provided by the network of pilot balloon stations of the U S Weather Bureau, which has for some years given a fairly detailed picture of upper winds over the United States from day to day, but it has to be remembered that bad weather often makes soundings with balloons impracticable There are wind roses showing the frequency of winds from different directions and the average velocity from each direction, and also wind roses giving resultant winds, for heights of 750, 1,500, 3,000 and 4,000 metres, for each month and for the year The stations number fourteen, the most northerly being Sault Ste. Marie, Michigan, nearly in latitude 47° N , and the most southerly Key West, a little south of latitude 25° N. ; consequently they range from the westerlies of middle latitudes down to regions under the influence of the trade winds, and allow instructive comparisons to be made between the upper winds in the two major wind zones. Laborious statistical work of this kind is, of course, necessary before simple generalisations can be made with confidence about the general circulation of the atmosphere The labour of compilation in this case must have been particularly heavy, for the number of individual observations at some of the stations numbered more than 300 for a single month, even at 4,000 metres, where they are least numerous, and more than a hundred thousand observations were used altogether

The Ionisation of Cæsium Vapour by Light The ionisation of the cæsium atom by absorption of light is apparently one of the simplest photo ionisation processes Kunz (*Phil Mag* , Supplementary Number, Feb) has measured the amount of ionisation produced per unit of energy by light of different wave-lengths, using cæsium vapour at very low pressures (down to the vapour pressure of cæsium at 25 C) He finds that the probability of ionisation falls from the series limit at λ 3184 to a minimum at λ 2800 and rises again at shorter wave-lengths Braddick and Ditchburn have also published (*Proc Roy Soc* , A , Jan) their measurements of the absorption of light in cæsium vapour (already announced in a letter to NATURE of January 28, 1933) They find that the absorption falls to a minimum about λ 2800 and rises again at shorter wave lengths In order to investigate the short-wave rise, they made careful experiments at different vapour pressures of cæsium, and showed that the absorption varied linearly with vapour pressure throughout the wave length range. The absorption therefore appears to be attributable to the cæsium atom and not to molecules The absolute value of the absorption coefficient at the longer wave-lengths leads to a value for the photo-ionisation which agrees with experiment Taking these results in conjunction with the photo-ionisation experiments of Kunz and of former workers, it seems almost certain that the absorption is practically entirely due to the atomic photoelectric process and that the probability of this process increases in the shorter wave part of the ultra violet This result is in sharp antagonism to existing wave-mechanical calculations, which predict a monotonic fall in the probability on the short wave side of the series limit.

A New Theory of Valency A paper on " A Theory of Valency Based on Wave Mechanics and Band Spectra" by Profs R F Hunter and R Samuel was read at a joint meeting of the Chemical and Physical Societies of Aligarh Muslim University on February 21 It was shown that assumptions such as those of the co-ordinate link and the singlet linkage are physically inadmissible, and that Lowry's theory of the semipolar double bond, although physically more sound than Sidgwick's theory of co ordination, is impossible for energetic reasons It was also suggested that Sidgwick and Bayliss's later contention with regard to the expansion of the valency group of hydrogen, that a second quantum group is permissible on Pauli's principle (*J Chem Soc.*, 2027 , 1930) has no physical meaning, since wave mechanics have proved that it is impossible for electrons to enter the 2 *s* group while the 1 *s* group already possesses its maximum number of electrons , the curve of the potential energy of the third electron having no minimum and exhibiting only *repulsion* from the system Pauling's recent deductions with regard to the structure of carbon monoxide (*J Amer. Chem. Soc* , **54**, 988 , 1932) were held to be neither correct on the basis of his assumed value of 3 volts per covalency, nor from the electronic configuration of the terms and their dissociation

Boston Meeting of the American Association

THE ninety-third meeting of the American Association for the Advancement of Science was held in Boston on December 27–January 2. Harvard University and the Massachusetts Institute of Technology, with which other colleges in the metropolitan area co-operated, were sponsors and furnished rooms and other facilities for most of the sessions, which were thus admirably provided for. The Boston area is a centre of outstanding interest. Its educational and scientific features were placed at the disposal of visiting men of science and added in significant fashion to the effectiveness of the meeting

The local committee, with Dr A L Lowell, president of Harvard University as honorary chairman and Dr. K T Compton, president of the Massachusetts Institute of Technology as honorary vice-chairman, provided well for the needs of the occasion Despite the violent attack of historical New England winter on the first day, the programme was carried through successfully, due to the work of Prof S. C Prescott, chairman, and his associates The attendance numbered more than 3,200 scientific workers and the programme included 1,475 papers All fifteen sections of the Association were active and 34 of its affiliated societies held meetings In addition, the Academy Conference brought together official representatives of 19 State academies of science on Wednesday. These affiliated academies are active agencies in the advancement of science in their particular regions and meet annually with the Association to discuss problems involved in their co-operation and to agree on plans for future work. Most secretaries of sections and of affiliated societies remained for a study of organisation problems on the day following adjournment.

A noteworthy event, not on the official programme, was the dinner given to Dr J. McKeen Cattell On December 27, before the opening session, one hundred and thirty representative members and friends gathered to show their appreciation and pay respect to him for distinguished services to the Association The feature of the programme was an address by Prof. John Dewey on "The Supreme Intellectual Obligation".

The first formal session on December 27 was opened with the president, Prof H N. Russell, in the chair After customary addresses of welcome and response, the retiring president, Dr. John J. Abel, of Johns Hopkins University School of Medicine, addressed the audience on "Poisons and Disease". He discussed the chemical nature of disease as demonstrated adequately for certain diseases such as lock-jaw and diphtheria and strongly suggested in many other cases, hence the current trend towards the view that all diseases are due to poisons As he said, "Nature has not affixed a poison label to any particular substance or class of substances; the pharmacist does that." Dr. Abel further pointed out that many materials in the human body, and even the vitamins, though necessary and helpful in limited quantities, become poisons in larger doses. "I incline to the belief," he stated, "that no living cell exists whose contents or metabolites are not toxic to some other living cell."

The second Hector Maiben lecture, an endowed annual event, was given by Prof. W. M. Davis on the topic, "The Faith of Reverent Science". In this he set forth his concept of the views of reverent science and the hope of the future in the growing co-operation between thinkers in the fields of science and religion

On December 28 the general session was in charge of Sigma Xi, the Society for the Promotion of Research. The speaker, Prof Henry E Sigerist, addressed the Society and guests on the topic, "The Foundations of Human Anatomy in the Renaissance".

The Sedgwick memorial lecture, which was established by the Biological Department of the Massachusetts Institute of Technology, was given on December 29 by Dr Henry Fairfield Osborn. The magnificently illustrated lecture was an effective presentation of the subject "Aristogenesis, the Creative Principle in the Origin of Species"

On the same day, the Chemistry section and the North-Eastern Section of the American Chemical Society meeting jointly were addressed by Prof. Lafayette B Mendel on "The Challenge of Nutrition to the Chemist".

The general session on Agriculture and Engineering on December 29, arranged with co-operation also of the section on Social and Economic Sciences, portrayed vividly the trend of the times. The Secretary of Agriculture, the Hon. Henry Agard Wallace, spoke on "What can Engineering do for Agriculture?" His address was an appeal to engineers to forsake *laissez-faire* philosophy and to join in building up a co-operative State. He charged scientific workers with failure to weigh social consequences and challenged the widespread self-centred attitude of the past "To-day when the industrial nations of the world have skimmed most of the cream off the backward nations and the backward classes and when there are no longer any challenging geographical frontiers to be conquered, it becomes apparent", he said, "that we must learn to co-operate with each other instead of joining together in the exploitation of someone else"

On December 30 the American Academy of Arts and Sciences, meeting jointly with the Association, presented the Rumford medal for distinguished research in physics to Prof. Harlow Shapley, director of Harvard College Observatory and Paine professor of astronomy at Harvard, after which he addressed the meeting on "The Anatomy of a Disordered Universe". He elaborated the view that while the universe as a whole may be expanding, that part of it closest to man shows the opposite tendency.

A series of well-organised joint sessions and symposia formed an important feature of the programme Indeed the entire three-day programme of the section of Medical Sciences consisted of a series of such features Of particular general interest were the symposia on "The Chemical Revolution" by the sections of Chemistry and Social Sciences, on "National Economic Policy in its Relation to Our International Policy" by the section of Social and Economic Sciences, on "New England Dialect and Colonial Culture", by the section of Historical and Philological Sciences, on the "Development and Growth of the Nervous System", by the section of Zoological Sciences, on the "Positron" by the section of Physics, on "Engineering and the Farm Problem" by the sections of Engineering, Agriculture, and Social and Economic Sciences.

Four of the prominent affiliated societies, namely, the American Society of Naturalists, the American Society of Zoologists, the Botanical Society of America, and the Genetics Society of America, held a joint session on December 30 on the theme "Biology and Society". Prof W. M. Wheeler spoke on "Animal Societies", Prof E. A. Hooton on "Primitive Human Societies", and Prof F. H Hankins on "Development of Modern Social Organization". The American Society of Parasitologists and the section of Medical Sciences in joint session presented a programme on the "Typhus Group of Organisms", with demonstrations which aroused great interest. Other joint sessions of affiliated societies on plant physiology, ecology, entomology, phytopathology, parasitology and dental research would merit special comment if space permitted.

On December 30 the American Society of Naturalists celebrated its semi-centennial anniversary. Prof S H Gage was honorary chairman. After dinner the anniversary address was delivered by Prof E G Conklin on "Fifty Years of the American Society of Naturalists". Prof B E Livingston read his presidential address on "Environments".

The addresses of the retiring vice-presidents, given at various times, included the following: *Mathematics*, Prof. H H Mitchell, "Linear Groups and Finite Geometries", *Physics*, Dr D. L Webster, "Current Progress in X-Ray Physics", *Chemistry*, Dr Frank C Whitmore, "Some General Aspects of the Polymerization and Depolymerization of Olefins", *Astronomy*, Dr P W Merrill, "Invisible Star Light", *Geology and Geography*, Dr. William H Hobbs, "The Glaciers of Mountains and Continents", *Zoology*, Prof. A. S. Pearse, "Ecological Segregation"; *Botany*, Dr. H. L. Shantz, "Botanical Research", *Anthropology*, Dr C. H Danforth, "Genetics and Physical Anthropology", *Psychology*, Dr Walter S Hunter, "The Stimulus Control of Behavior during and after Learning", *Education*, Prof Stuart A. Courtis, "Differential Testing as a Method of Psychological Analysis", *Social and Economic Sciences*, Prof William F. Ogburn, "Recent Trends in Social Sciences", *Historical and Philological Sciences*, Dr. Waldo G Leland, "Recent Trends in the Humanities"; *Engineering*, Prof. Dugald C. Jackson, "The Origins of Engineering", *Medical Sciences*, Dr. C. R. Stockard, "Internal Secretions and Genetic Quality in Structural Development"; *Agriculture*, Prof. Joseph H. Gourley, "Plant Anatomy as a Tool in Agricultural Research".

The Science Exhibition, now a regular feature of the annual meeting, was, despite adverse economic conditions, the most successful yet undertaken. Colleges, private and Government research laboratories presented new and important work, both in pure and applied science, commercial exhibits of apparatus and products were extensive, among the displays of publications in science those of university presses were conspicuous, and the exhibits made by associations of teachers in biology, physics and mathematics attracted marked attention.

The Committee on the Place of Science in Education had arranged a special conference in which relations between teaching and the advancement of science were discussed from diverse points, and the results of new experiments in laboratories, science clubs and State academies reported.

The American Association prize of 1,000 dollars was awarded by the Committee on Awards to Dr Reuben L Kahn, bacteriologist of the University of Michigan, for his paper on "Tissue Reactions in Immunity: the Specific Reacting Capacities of Different Tissues of an Immunized Animal". By a method of measuring the degree of immunity acquired by different tissues, as shown by the author's investigations, warfare against germ diseases may be more successfully conducted.

The British Association was represented at the meeting by Prof. Arthur E Kennelly of Harvard and Prof F E Lloyd of McGill, the French Association by Prof W M Davis of Harvard, and the Bohemian Royal Society by Prof Henry B Ward of Illinois. Special delegates were also appointed by many American institutions.

The following officers were elected for the year 1934: *President*, E L Thorndike of Columbia University, *Council Members*, F K. Richtmyer of Cornell University, J C Merriam of Carnegie Institution, *Members of the Executive Committee*, K T Compton of the Massachusetts Institute of Technology, E G. Conklin of Princeton University; *Trustee of Science Service* for three years, to April 1937, J McKeen Cattell, *Vice Presidents of the Sections*, 1934: R D Carmichael, mathematics, H G Gale, physics, Joel H Hildebrand, chemistry, Frederick Slocum, astronomy, Jas B Macelwane, geology and geography, George L Streeter, zoological sciences, B O Dodge, botanical sciences, M J Herskovitz, anthropology, John E Anderson, psychology, Carl Snyden, social and economic sciences, Solon J Buck, historical and philological sciences, C. E Skinner, engineering, Cyrus C. Sturgis, medical sciences, J. G. Lipman, agriculture; Guy T Buswell, education, *Secretary of Section I*, John A McGeoch.

HENRY B WARD

Invention and Legislation

AT the sixth annual general meeting of the Television Society held at University College, London, on March 14, an address was given by the president, Sir Ambrose Fleming, on "Invention in Relation to National Welfare and its Legislative Control". Sir Ambrose referred to progress in television as an instance of one of the most interesting of the technical applications of science. It fulfils the same function with regard to the eye that radiotelephony does for the ear. It annihilates distance and enables us to see living and moving objects which would otherwise be invisible. In short, it enables us to be in two places at the same time. We are then led to consider the question how such an achievement can be made to contribute to national welfare, apart from its interest as a mere scientific novelty or amusement.

The great advances made in the use of short electric waves and closer scanning, and in photoelectric cells and cathode ray tubes, have made corresponding advances possible in television, and we can now transmit images of pictures, diagrams, or living persons and reproduce them on screens 3–4 ft. square, visible to large audiences at the receiving stations. We have in this ability a valuable means of education. Lectures and school lessons can be given by radio speech and illustrated by television diagrams or pictures Botany, astronomy, physiology and other sciences can thus be taught by visible diagrams A critic might say that this will diminish the demand for science teachers On the other hand, it would render possible the services of very able men and women of special knowledge and teaching power This particular application of television has scarcely yet been touched Where mere entertainment is desired, it will before long be possible to transmit special films of moving objects and, as it were, to bring the cinema into every home

These replacements which invention brings about force us into consideration of the question how far mechanical invention at the present day is responsible for the large scale unemployment which afflicts the world ? Different answers are given to this question Some hold that the replacement of manual power and skill by machine power which does ten or hundred times as much in the same time, is a fundamental cause of present distresses Others think that a primary reason is the deficient organisation in business, and that our methods of production have outrun our power of distribution Probably a still more basic cause is the enormous waste of world wealth and natural resources in wars and preparation for wars Humanity has not yet learnt how to live as one family or society and not as a collection of enemies and contesting rivals

Invention, however, requires guidance and control, and it is difficult to introduce new methods and ideas when any one branch of activity has become centralised in a few hands or petrified by becoming a Government monopoly This makes it necessary to point out how many disadvantages arise from erroneous or premature legislation intended to control invention This may be illustrated by the history of telegraphy, telephony, electric lighting and wireless telegraphy When after 1837 electric telegraphy became practicable by numerous inventions, public companies were formed to exploit it About 1866 or so, an opposition began to be raised to the growth of what was called another 'monopoly' The British Government of that day then passed Acts of Parliament in 1868–69 to enable it to buy out the telegraph companies and to place electric telegraphy under the control of the General Post Office

These Acts were, however, drawn with such skill that even ten years later when the telephone was invented and exchanges established, telephony was held to be subject to the above Acts Unfortunately, this decision rested merely on a judgment given in a court of first instance and was never confirmed by a higher court The General Post Office offered the telephone companies a licence for thirty years in exchange for a royalty of 10 per cent on their receipts. During those thirty years it took nearly a million and a half sterling from the telephone, but it blocked the way to advances in the art during all that time

The same story was repeated with electric incandescent domestic lighting In 1882 the Government passed an Act ironically termed an Act to "facilitate" it, but in fact it simply 'throttled' it for six years until an amending Act was carried in 1886 A similar fate attended wireless telegraphy In 1904 it was placed under the control of the Postmaster-General In 1926, when broadcasting of speech and music had become an important service, a charter committed it to the domination of the B B C and its small group of governors Television is now also in the control of the same power and the only chance given to prove its utility is at 11 p m., when few people have use for it.

Accordingly it is clear that premature legislation can easily cripple a nascent industry and bind it in bandages of red tape It is beyond defence that an invention which was not dreamt of at the date of a certain Act of Parliament should be controlled by that Act

In conclusion, Sir Ambrose Fleming advocated an extension of the period of patent protection, which at present is fourteen years in Great Britain, unless specially extended An invention is no use to the public until it becomes practically available or commercialised, and this generally requires time and great expenditure It is not possible to secure this without some reasonable prospect of return upon the capital, and in most cases a large part of the period of patent protection has elapsed before the point of commercial success is reached

University and Educational Intelligence

Cambridge —Dr R Stoneley, lecturer in applied mathematics in the University of Leeds, and Dr H M Taylor have been appointed University lecturers in mathematics

The Vice-Chancellor has appointed Dr A H Gardiner to the Frazer lectureship in social anthropology for the year 1934–35

Dr W H Thorpe and Dr W H Mills have been appointed to represent the University at the Eighth International Ornithological Congress to be held in Oxford on July 2 7

Prof E B Verney, professor of pharmacology at University College, London, has been appointed to the Sheild readership in pharmacology as from October 1

Edinburgh —The Senatus Academicus of the University has resolved that the honorary doctorate in laws be offered to the following, among others, for conferment at the graduation ceremonial to be held on June 28 Dr R Hutchison, physician to the London Hospital , Sir John Stirling-Maxwell, formerly chairman of the Forestry Commission and of the Royal Fine Art Commission for Scotland, chairman of the Ancient Monuments Board (Scotland) , Prof R Robinson, Waynflete professor of chemistry in the University of Oxford , Prof D'Arcy W Thompson, professor of natural history in the University of St Andrews

Applications, which must be received not later than April 15, are invited for the following scholarships awarded by the Council of the Institution of Electrical Engineers Inquiries for full particulars and nomination forms (specifically mentioning the name of the Scholarship) should be addressed to the Secretary of the Institution, Savoy Place, London, W C 2 Duddell scholarship (£150 per annum for 3 years), for candidates less than nineteen years of age on July 1 , Ferranti scholarship (£250 per annum for 2 years), for candidates less than twenty-six years of age on July 1 ; Swan memorial scholarship (£120 for 1 year), for candidates less than twenty-seven years of age on July 1 , Silvanus Thompson scholarship (£100 per annum and tuition fees, for 2 years), for works employees less than twenty-two years of age on July 1

Science News a Century Ago

University Tests

In the spring of 1834 there was, wrote Airy, who was then Plumian professor at Cambridge, "a furious discussion about the admission of Dissenters into the University." The repeal of the Corporation and Tests Acts in 1828 had removed many of the disabilities under which Dissenters laboured, but they were still unable to obtain degrees at either Oxford or Cambridge. Efforts to bring the matter before the Senate at Cambridge having failed, on March 21, 1834, Earl Grey, the Prime Minister, presented a petition in the House of Lords from certain members of the Senate praying for the abolition by legislative authority of "every religious test exacted from members of the University before they proceed to degrees, whether of bachelor, master or doctor, in arts, law and physic." In praying for the removal of these restrictions, the petition said, they were only asking for "a restitution of their ancient laws and laudable customs. These restrictions were imposed on the University in the reign of James I, most of them in a manner informal and unprecedented, and grievously against the wishes of many of the members of the Senate, during times of bitter party animosities. . . ." In a speech on the occasion, the Duke of Wellington remarked that the petition was nothing more than the petition of a dissatisfied minority though consisting of most respectable individuals, praying the House to interfere with the regulation of the University, in defiance of the immense majority of the Senate.

On March 24, the same petition was presented in the House of Commons by Mr. Spring Rice, but the petition was vigorously opposed by Mr. Goulburn, one of the members for the University of Cambridge. On April 17, Col. Williams moved that an address be forwarded to the King "requesting His Majesty to signify his pleasure to the Universities of Oxford and Cambridge respectively, that these bodies no longer act under the edicts or letters of James I, 1616." It was, however, determined to proceed by bill, and by 185 votes to 44 leave was given to bring in a bill to grant His Majesty's subjects generally the right of admission to the English universities, and to equal eligibility to degrees therein, notwithstanding their diversities of religious opinion, degrees in divinity alone excepted. The second reading of the bill was passed on June 20 by 321 votes to 174 and the third reading on July 28 by 164 votes to 75. When the bill was sent to the House of Lords, it was nevertheless rejected.

Among the most notable speeches in its favour was that of Lord Brougham, then Lord Chancellor. He supported the bill because it removed a practical grievance. "Surely," he said, "it was a great practical grievance, that instead of being admitted into one of the most illustrious, most ancient, and justly renowned seminaries of public learning, he should be forced to seek for education in another country. . . . Was it nothing that as a professional man he should not be admitted to the degree of a doctor of medicine, because he was not a member of the Church of England, and that to practise the faculty of medicine he must go to Berlin, or Paris, or Edinburgh or Glasgow? This was a law which savoured of oppression and was a practical grievance of great weight." He could not understand, he said, the consistency of those who gave the Dissenter admission to both branches of the legislature which must control the universities, and yet refused him admission to those very universities.

Discovery of the Tea Plant in India

Towards the end of the eighteenth century the difficulties which attended trading with China compelled the East India Co. to consider the possibility of growing various commodities, notably tea, in India. Sir Joseph Banks advised the Company that parts of Bengal would probably be suitable for the purpose. In 1826, the Commissioner in Assam had sent to Calcutta leaves of a shrub indigenous to that area which he believed to be a wild tea plant. This was not immediately accepted by the authorities, and it was not until the spring of 1834 that it was established that the genuine tea plant was native to India. Thereafter, the cultivation of tea became more and more extensive in India, the monopoly of the East India Co. was abolished, and India became ultimately the main tea growing country in the world.

In an article in Loudon's *Gardener's Magazine* of August, 1835, Dr. Wallich gives some details of the discovery made the year before. A commission, of which he was chairman, had been appointed to investigate the situation and reported "that we are enabled to announce that the tea shrub is, beyond all doubt, indigenous in Upper Assam. . . . We have no hesitation in declaring this discovery, which is due to the indefatigable researches of Captain Jenkins and Lieutenant Charlton, to be by far the most important and valuable that has ever been made in matters connected with the agricultural or commercial resources of this empire. We are perfectly confident that the tea plant which has been brought to light will be found capable, under proper management, of being cultivated with complete success for commercial purposes. . . . We are acquainted with the fact that the late ingenious Mr. David Scott sent down from Munipore specimens of the leaves of a shrub which he insisted was a real tea." By 1835 tea nurseries had been established in various parts of Northern India and the beginnings of the tea industry firmly established.

Improved Apparatus for Making Ship's Biscuits

In 1834, food scales in naval and merchant ships were unbalanced and rough. The subjoined statement by the Society of Arts relates to the award of a special premium during the session 1833–34, for an improved industrial process for the making of ship's biscuits:—"The large gold medal has been voted to Thomas R. Grant, of Weovil, near Portsmouth, for his improved apparatus for the manufacture of ship's biscuits. The apparatus was first erected at Weovil in 1832, under the immediate superintendence of Sir John Rennie. In Mr. Grant's apparatus the greater part of the labour is performed by steam power; the nine ovens in use are heated by one continuous fire-place, the flame of which is admitted by means of a register into each oven as soon as the previous charge has been withdrawn, and in five minutes brings it to a sufficient heat. The advantages claimed are superior economy and expedition, and better quality in the article. The present mode of making ship's biscuits involves, amongst the first operations, the mixing, by a man, of meal and water in due proportions; the kneading the dough for half an hour with his naked arms plunged up to the elbows, finishing by jumping into the dough and kneading with his feet A perfect and uniform mixture cannot result, shown later in some ship's biscuits being thin, some thick and scaly" (*Trans Soc. Arts*, 50, 7, 1834–35) The Society inspected an installation of this apparatus set up by a firm at Wapping

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Societies and Academies

LONDON

Royal Society, March 8 J **Chadwick**, P M S **Blackett** and G **Occhialini** Some experiments on the production of positive electrons The emission of positive electrons has been observed under different experimental conditions (1) from a lead target exposed to the γ-rays of thorium active deposit (2) directly from a source of thorium active deposit, (3) from a lead target exposed to the radiations (γ-rays and neutrons) emitted by beryllium, boron, and fluorine when bombarded by polonium α-particles The measurements of the energies of the positrons ejected from lead by the thorium γ rays support the view that a positron and an electron are produced simultaneously by the interaction of a γ ray and an atom, and that the mass of the positron is the same as that of the electron The positron and electron are probably created in the electric field outside, rather than inside, the nucleus The observations show that when γ-rays of high frequency pass through an appreciable fraction (about one fifth for a γ-ray of $h\nu = 2{\cdot}6 \times 10^6$ volts) of the energy absorbed is used in this process of creating a positron and an electron G **Temple**: The quantum theory of the neutron This paper develops a theory of the neutron on the basis of the second order wave equation for the hydrogen atom, $(F^2 + m_0{}^2c^2)\psi = 0$, where F is Dirac's wave operator This equation possesses two types of solutions for which $\int_0^\infty \psi^2 r^2 dr$ is finite—the type H which yields the accepted wave functions of the hydrogen atom, and the type N which is here identified with the wave functions of the neutron Certain properties of the neutron are deduced from the form of the N solutions

Physical Society, Jan 19 E O. **Willoughby**: The measurement of the inductance of iron-cored chokes carrying direct current A method for measuring, by means of a reflecting dynamometer ammeter, the inductance of an iron-cored coil is described The coil is connected in series with a capacity and the ammeter, and then the junction of the inductance and capacity and the junction of the fixed and moving coils are connected to an A C. supply. For a constant applied voltage the deflection of the dynamometer ammeter is proportional to the square root of the reciprocal of the inductance This is also true when a direct current is superimposed on the alternating current flowing through the inductance Advantages of the method are the simplicity of the instruments and of the observations taken, the small value of the alternating current used and the independence of the method within wide limits of the frequency and wave-form of the supply. G. A. **Whipple**: A high-vacuum leak device The device described was designed for the control of pressure in the discharge tube of cold-cathode cathode ray oscillographs. It operates on a diffusion principle, and in this case permits of continuous variation of discharge tube pressures from 0·5 mm mercury to 'black' vacuum at 70 kilovolts. C. H. **Collie**: The use of charcoal in maintaining high vacua. Measurements have been made of the limiting pressures reached by charcoals and silica gels cooled with liquid air or liquid hydrogen when a small, constant stream of gas is admitted into the apparatus R A. **Fereday** On some measurements of magnetic susceptibilities at high temperatures Details are given of an electromagnet which has been specially built for carrying out measurements of small susceptibilities by a method, previously described by the author, in which specially designed pole-pieces are used. The method is applicable whether the pole-pieces are or are not saturated An apparatus for the determination of susceptibilities at high temperatures is described in detail. J. S. **Preston** and L. H. **McDermott**. The illumination-response characteristics of vacuum photoelectric cells of the Elster-Geitel type. The authors deal with the present status of the vacuum photocell as regards proportionality of photoelectric current to incident illumination, and give a series of observations which show that while excellent cells are obtainable, their employment for precise work without a previous test is unsafe A theory is developed which accounts for the observed results Attention is directed to the dependence of the illumination characteristic upon the colour of the light employed.

PARIS

Academy of Sciences, January 22 (*C R*, 198, 294–408) The president announced the death of Pierre Bazy, member of the Section of Medicine and Surgery. **Jules Drach** The quadratic integrals of the equations of dynamics and the conjugated systems of Euclidian space of n dimensions J **Costantin** New ideas in connexion with potato disease (*Enroulement*). On repeating the experiments of Newton on the effects of altitude on potato diseases, it is concluded that high altitude does not cure such diseases, but causes them to become less virulent. These results suggest the possibility of realising true vaccinations of plants **Pierre Weiss** A series of coefficients intervening in certain phenomena depending on thermal agitation **Louis Roy**. The apparent diameter of the stellar discs J. **Cabannes** and J **Dufay** The spectral analysis of the light of the nocturnal sky at the Pic du Midi Besides a continuous spectrum, with dark Fraunhöfer lines, there are present a large number of emission bands and lines, the most intense of which is the green line of the polar aurora A list of these lines is given. These are shown to be emitted in the upper atmosphere. **Edouard Chatton**. The peridinian origin of the Radiolaria and the parasite interpretation of anisosporogenesis **Antonin Gosset** was elected a member of the Section of Medicine and Surgery E J. **Gumbel**: The moments of the final distributions of the mth value **Paul Alexandroff**: The Betti groups at a point. B **de Kerékjártó**: The topological character of conformal representations. A. **Rosenblatt**: The biharmonic equation with two independent variables **Chadenson**: Mean square functions capable of summation. **Mandelbrojt**: A new quasi-analytical class of indefinitely derivable functions V. A **Kostitzin**: The mathematical study of the problem of glacial periods. L. **Pontrjagin**: Continued Abelian groups J **Delsarte**: Mean periodic functions. **Ary J. Sternfeld**; A method of determination of the trajectory of a body in movement in interplanetary space by an observer connected with the mobile system **L Santon** A supersonic blower with a high velocity coefficient **L Couffignal** The mechanical balancing of rotating masses **A Martinot-Lagarde**. An anemometer insensitive to changes in the direction of the wind A modification of the Dines anemometer **V Grouitch** Occultations of stars by the moon observed at Strasbourg from 1925 until 1932 Reductions and discussion **Emmanuel Gambetta** The measurement of small light intensities by means of the photoelectric cell **René Audubert** and **Jean Roulleau**. The influence of water in certain rectifying contacts Rectifiers containing powders of metallic salts are affected by the presence of moisture in the powders **Quintin**. The rôle of the barrage layer in rectification by imperfect contact **J Mercier**. The possible different types of electrical oscillations **M Pauthenier** and **Mme. Moreau-Hanot** The influence of isolated conductors on the coronal discharge **Th V Ionescu**. The propagation of energy in tubes containing ionised gases **Ny Tsi-Zé** and **Voo Shueh-Ling**. The continuous spectrum of neon **D Séférian**. The spectrum of atomic nitrogen (N I) in ammonia and in mixtures of hydrogen and nitrogen **Maurice Curie** and **F Joliot**: The radioactivity of samarium About a year ago Hevesy and Pahl showed that samarium emitted α rays The authors, using another method, obtain results confirming the radioactivity of samarium. **La Goldstein** Recoil atoms in gaseous media **Pierre Auger**: On the γ-rays produced by the passage of neutrons through hydrogenated substances. The author has studied the curvature of the trajectory of the particles in a magnetic field of 7000–8000 gauss The results are not in accord with the interpretation by Lea of these phenomena **P Savel**. The complex radiation excited in aluminium by the α-particles **W Broniewski** and **K Wesolowski** The structure of the gold copper alloys Curves are shown for melting points, electrical conductivity, temperature coefficient of the electrical conductivity, thermoelectric power, and linear coefficient of expansion Different curves were obtained in some cases when slowly cooled or tempered alloys were taken No indication of the existence of the compound Au_2Cu_3 was obtained. **Ernest** and **Marcelle Kahane** A general method for the determination of sulphur in organic substances The oxidation is carried out with a mixture of nitric and perchloric acids in the presence of a small proportion of iodic acid **R Paul**: Bromine derivatives of tetrahydropyrane **Marcel Casteras**. The tectonic of the north slope of the Pyrenees. **L Dubertret** The deposits of mineral hydrocarbons in Syria and Liban. **J Gubler** The stratigraphic value of the Fusulinidese of the Permian **Paul Guérin**: Hydrocyanic acid in the Gramineæ: *Melica* and *Gynerium*. **H Colin** and **Mlle J. Payen**. The sugar of *Rivularia bullata*. **A.** and **R. Sartory**, **J Meyer** and **Ernst**: The inhibiting influence of radium on the growth of the rootlets of *Lens esculenta*. Modifications of the minimum hindering dose under the influence of favourable ions **André Kling**, **J Froidevaux** and **Félix Dubois**. The rôle of the fatty material contained in flours. **A Maublanc** and **Roger**: Phthiriosis of the coffee plant. **Marcel Baudouin** The age at which birds can migrate. From the experiments described it would appear that birds can migrate when six months old. **Mme. Lucie Randoin** and **Roger Netter** *A* avitaminosis and the utilisation of lipids **J Donato**, **R. Jacquot** and **H Penau**: The influence of vitamins A and D on the humoral reactions in human tuberculosis **Nils Stendal** The presence of salicylic acid and of phenylacetic acid in the acetone-soluble fat of the tubercle bacillus **Raymond Hovasse**: Ebriaceæ, Dinoflagellæ and Radiolaria **Mlle Berthe Biecheler**. A dinoflagellan with perinuclear capsule, *Plectodinium nucleovolvatum* and on the relations of the peridinians with the Radiolaria

VIENNA

Academy of Sciences, November 23 **Otto Brunner** and **Rolf Wöhrl**. Chemistry of bark substances (2); components of hazel bark This bark contains a hydrocarbon, lignoceryl alcohol, sitosterol and a resinol $C_{30}H_{50}O_2$, which is identical with the betulin of birch bark The corylol and the sterol of m p 200° found by Zellner and Feinberg (1923) are merely mixtures of betulin and sitosterol **Otto Brunner** and **Franz Grof** Synthesis of 1-ethyl 6-methyl- and 1-ethyl-7-methyl-naphthalene These synthesised hydrocarbons are both different from that obtained on dehydrogenation of amber, for the latter the constitution 1 2 5-trimethylnaphthalene is thus confirmed **Hans Mayerhofer** Conditions for the production of thorium B + C preparations The best metallic precipitant, time of activation, temperature, etc, for obtaining Th C and Th B + C have been determined **Kasimir Graf** Brightness of comet 1932*n* (Dodwell-Forbes). Photometric observations during two months at the Porto Cristo station in Mallorca show that, apart from occasional short deviations, this comet shows a smooth brightness curve which may be represented satisfactorily by the reduced brightness 7 83 mag and by the exponent 5 8 in the radius vector **Walter Bernheimer** Intensity of ultra-violet solar radiation (λ 3200) between April 1925 and June 1933 This radiation varies with the time, but during two thirds of the whole time of observation the variation was absolutely opposed to the sunspot periodicity. The positive correlation between the solar constant and the ultra-violet radiation, required by theory, was not observed. **Alexander Tornquist** The mineral deposits of the Dolomites and Venetia (1) the pyrites mass of Agordo **K Heinz**: Observations on the cytology of the species *Polygonatum* and *Convallaria*. **L. Sladović** Attack of metals by liquid, binary, organic systems. Iron and aluminium were not attacked by the systems examined Copper, however, was acted on more rapidly by the systems aniline-phenol, aniline-nitrobenzene, and pyridine-phenol—all of which form compounds in the liquid phase—than by the separate components On the other hand, benzene-aniline, which forms no molecular compound, is less corrosive than its constituents. **Gustav Götzinger** and **Vilhelm Milthers** The northern quaternary of Silesia and Moravia. **Karl Hölzl** Recent investigations in East Salzkammergut

November 30 **Franziska Seidl**. Action of radium radiation and X-rays on piezo-quartz Experiments with a number of quartz plates show that increase of the piezo-constant by radioactive radiation or X-rays apparently depends on the magnitude of this constant in the non-irradiated state, and that the increase in conductivity caused by the irradiation must also be considered **Ernst Beutel** and **Artur**

Kutzelnigg Sorption of iodine by fibrous materials (1) vegetable fibres Ernst Beutel, Herbert Haberlandt and Artur Kutzelnigg. Coloration of marble in iodine vapour and the nature of the polished layers When exposed to dry iodine vapour, marble assumes a yellow or reddish-brown coloration, the intensity of which is greatest for sawn surfaces. Polished surfaces also are deeply coloured, but those etched by acid, grinding or sand blasting are coloured to less extents It is considered that the polished surface layers consist of crystallites of colloidal dimensions, their marked sorptive capacity resulting from the accumulation of granule boundaries. Artur Kutzelnigg (1) Change in certain properties of zinc oxide in consequence of mechanical demands Subjection of zinc oxide to grinding or pressing produces marked alteration of the colour and luminescence effects (2) Fluorescence of zinc oxide at the temperature of liquid air The fluorescent properties of various zinc oxide preparations are greatly enhanced when the oxides are cooled in liquid air Otto Brunner and Franz Grof Synthesis of 1 methyl 2 ethyl- and 1-ethyl-2 methyl-naphthalenes Andreas Thurner Explanation of the stratigraphic relationships in the mountain region around Murau

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Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, March 19

British Museum (Natural History), at 11 30—Capt Guy Dollman "Animals Recommended for Protection in Africa" *

Royal Geographical Society, at 8 30 —Miss Mildred Cable "The Bazars of Tangut and Trade Routes of Dzungaria"

Tuesday, March 20

Eugenics Society, at 5 15 (in the rooms of the Linnean Society, Burlington House, Piccadilly, W 1)—Prof R J A Berry 'Some Modern Views of the Human Mind and its Disorders" (Lantern Demonstration) *

Wednesday, March 21

Royal Meteorological Society, at 7 30 (in the hall of the Royal Geographical Society)—J M Stagg 'The British Polar Year Expedition to Fort Rae, Canada, 1932–33"

Royal Society of Arts, at 8—D S Richards 'Wireless Communications with the Mount Everest Expedition, 1933"

Royal Entomological Society of London, at 8—K R S Morris "Entomological Excursions in West Africa" (Film)

K Mellanby. "Factors Causing Insect Death"

Friday, March 23

Royal Astronomical Society [Geophysical Meeting], at 4 30—Discussion on "Oceanic Circulation" to be opened by D J Matthews

Institution of Professional Civil Servants, at 5 45 (at the Royal Society of Arts).—J M Stagg "The British Polar Year Expedition to Fort Rae, Canada, 1932–33" *

Royal Institution, at 9.—Lord Rutherford "The New Hydrogen"

Institution of Naval Architects, March 21–23—Annual meeting at Royal Society of Arts

Society for Experimental Biology, March 23–24.—Thirtieth annual conference to be held at Oxford

Official Publications Received

Great Britain and Ireland

The Scientific Proceedings of the Royal Dublin Society Vol 20 (N S), No 41 The Trees of Ireland, Native and Introduced By H M Fitzpatrick Pp 597–656 (Dublin Hodges, Figgis and Co, London Williams and Norgate, Ltd) 3*s*

Reports on the Museums of Ceylon, British Malaya, the West Indies, etc Pp 58 Directory of Museums in Ceylon, British Malaya, Hong Kong, Sarawak, British North Borneo, Fiji, the West Indies, British Guiana Pp 67 (London Museums Association) Reports, with Directory, 5*s*

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1551 (T 3477) The Radially Braced Airship Ring By Prof L Bairstow Pp 28+3 plates 1*s* 6*d* net No 1559 (T. 3427) Use of Networks to Introduce Turbulence into a Wind Tunnel By E Ower and Dr R Warden Pp 8+4 plates 6*d* net No 1560 (T 3346, revd) Heat Transmission through Circular, Square and Rectangular Pipes By A Bailey and W F Cope Pp 11+8 plates 9*d* net No 1561 (T 3430) Flow near a Wing which Starts Suddenly from Rest and then Stalls By Aeronautics Laboratory, Cambridge Pp 9+8 plates 1*s* net (London H M Stationery Office)

Directory of Museums and Art Galleries in Australia and New Zealand Compiled by S F Markham and Dr H C Richards Pp 115 (London Museums Association)

Beer By H F E Hulton (Sixteenth Streatfeild Memorial Lecture, 1933) Pp 34 (London Institute of Chemistry)

Ministry of Agriculture and Fisheries Leaflets on Insect Pests of Farm and Garden Crops (34 Leaflets) Pp iv+140+8 plates (London H M Stationery Office) 1*s* 6*d* net

Other Countries

Records of the Indian Museum Vol 35, Part 2 Notes on Fishes in the Indian Museum 20 Loaches of the Genus *Nemachilus* from Baluchistan, 21 On a New Species of *Nemachilus* from Kohat N W F Province By Dr Sunder Lal Hora Pp 183–191+plate 5 Vol 35, Part 3 Remarks on Tonnoir's Theory of the Evolution of the Ventral Suckers of Dipterous Larvæ By Dr Sunder Lal Hora Pp 284–286 Vol 35, Part 4 Siluroid Fishes of India, Burma and Ceylon 1 Loach like Fishes of the Genus *Amblyceps* Blyth By Dr Sunder Lal Hora Pp 607–621 (Calcutta)

Report of the Aeronautical Research Institute, Tôkyô Imperial University No 100 The Lift Acting on a Flat Plate in a Stream bounded by an Infinite Plane Wall By Susumu Tomotika Pp 115–156 30 sen No 101 The Lift on a Flat Plate placed in a Stream between Two Parallel Walls and some Allied Problems By Susumu Tomotika Pp 157–227 45 sen (Tôkyô Koseikai Publishing House)

Southern Rhodesia Meteorological Report for the Year ended 30th June 1933 Pp 59+1 plate (Salisbury Government Printer)

Southern Rhodesia Geological Survey Bulletin No 26 The Larger Gold Mines of Southern Rhodesia Compiled by B Lightfoot Pp 106 (Salisbury Geological Survey) 1*s* 3*d*

South Australia Department of Mines *Mining Review for the Half Year ended June 30th, 1933* (No 58) Pp 62+6 plates (Adelaide Government Printer)

Dominion of Canada Report of the Department of Mines for the Fiscal Year ending March 31, 1933 (No 2338) Pp iii+43 (Ottawa King's Printer) 25 cents

Canada Department of Mines Geological Survey Economic Geology Series, No 15 Oil and Gas in Western Canada By G S Hume Second edition (No 2128) Pp v+359 (Ottawa King's Printer) 75 cents

Canada Department of Mines Mines Branch Investigations of Mineral Resources and the Mining Industry, 1932 (No 735) Pp 31 (Ottawa King's Printer)

Canada Department of Mines National Museum of Canada Bulletin No 71 Annual Report for 1932 Pp 25 (Ottawa King's Printer) 10 cents

Bulletin of the Department of Indian History and Archæology, No 1 Some Aspects of the Vâyu Purâna By V R Ramachandra Dikshitar Pp iii+52 (Madras The University) 1 rupee, 2*s*

Journal of the Indian Institute of Science Vol 16A, Part 10 Extension of Michael's Reaction, Part 3 By Tejendra Nath Ghosh and Praphulla Chandra Guha Pp 103–112 (Bangalore) 12 annas

Allahabad University Studies Edited by the Vice-Chancellor and the Heads of Departments Vol 9, Part 1 (Arts Section) Pp iv+205 7 8 rupees Vol 9, Part 2 (Science Section) Pp iv+126+3 plates 7 8 rupees (Allahabad)

Ministry of Finance, Egypt Chemical Department Report on the Work of the Chemical Department in the Financial Year 1931–1932 Pp 63 (Cairo Government Press) 5 P T

Pennsylvania State College School of Agriculture and Experiment Station Bulletin 302 The Respiration Calorimeter, a Description of the Construction and Operation of the Respiration Calorimeter for the larger Farm Animals at the Pennsylvania State College By Winfred W Braman Pp 36 (State College, Pa Experiment Station)

Carnegie Institution of Washington Publication 447 Contributions to Palæontology, Marine Animals By Earl L Packard, Remington Kellogg and Ernst Huber Pp iii+136+8 plates (Washington, D C Carnegie Institution)

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SUPPLEMENT.
Liquid Crystals. By Sir William Bragg, O.M., K.B E., F.R.S. 445

Scottish Chemical Industries

THAT it should become necessary to re-inspire Scotsmen with a belief in their own country seems strange indeed to those who dwell south of the Tweed, where the frequent demonstration of northerly patriotism is received with good-humoured tolerance and not a little pride. Scottish industry, however, is in different case from her highlands or her history, so that it has been thought desirable to enlist voluntary help in the promotion and development of all branches of industry in Scotland, and in that re-inspiration which will lead through confidence to ordered effort and material success Such a voluntary, non-political, non-trading organisation is the Scottish National Development Council, which was formed in 1931 under the auspices of the Convention of Royal Burghs and the Association of County Councils in Scotland. The Council, which enjoys the patronage of H R H the Prince of Wales and has as president the Earl of Elgin and Kincardine, undertook last year the task of constituting a number of expert technical committees to investigate and report on the present position and tendencies of industry in Scotland, on "the advantages enjoyed and the handicaps borne by Scotland in comparison with England and other competing countries, and to make recommendations for the exploitation of the former and the alleviation of the latter" It was considered important to examine the state of the chemical industry as soon as possible, and a survey of the position in that sphere of national activity has now been published*

The report opens with a significant phrase "The chemical industry," it states, "has never been of outstanding importance in Scotland—unless one views it in its widest scope, in which almost every industry is chemical " In the latter assertion lies justification for the insistence with which is advocated, in responsible scientific and industrial quarters, a wider recognition of the fundamental place of chemistry, of course with its correlated sciences, in preparation for industrial careers, particularly in preparation for the tasks which fall to the industrial and political directorate. In these columns the value of chemical science as an educational apparatus, in addition to its obvious claim to a prominent place among vocational subjects, has often been emphasised ; once again we assert that the study of chemistry need not always premise a career at the bench or in the factory, but that it provides a background of rational method and specific information which is of the greatest value in the ramifications of modern industrial and economic life. Such training could not but lead, for example, to a greater appreciation in financial circles of the material benefits to be derived from scientific research properly organised and adequately financed, and to a far more widespread determination, where power already exists, to recruit the 'shock brigades' of research in the van of progressive industry. The report remarks, in fact, that competition with regard to many chemicals is world-wide, and that their manufacture, dependent as this is upon research, highly-skilled control, and the use of large and modern plant, can be carried out only by those organisations which are capable of affording all those requirements.

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* Report of the Committee on the Chemical Industry in Scotland. Scottish National Development Council Economic Series, No 9 (Glasgow, 39 Elmbank Crescent) 6d net.

Taxation and transport are other considerations of prime importance in industrial development. We are reminded that shrinkage of business caused by over-taxation, or by fear of over-taxation, expresses itself in general lack of confidence; this holds up enterprise on the part of existing firms and restrains new firms from setting foot in certain areas. The suggestion is made that districts which have advantages, such for example as reasonable rates, should advertise these and thus attract new ventures. It is surely in the end profitable for rating authorities to make only such demands as, in their informed judgment, will assist local industry and employment to expand and will attract new industries, with their corollaries of greater employment, more local trade, and a longer valuation list. This consideration appears especially pertinent in Scotland in view of the southward drift of industry towards large centres of population, although the existence of cheap rail or sea transport may prove a deciding factor. However, Scotland is well placed geographically for export markets, and the extension of motor transport is encouraging.

It is satisfactory that the report recognises that no useful purpose would be served by endeavouring to favour one portion of Great Britain at the expense of another in defiance of sound economic principles. "The considerations which govern the establishment and growth of an industry are, or should be, purely economic, and any departure from this standpoint is bound to be attended sooner or later with financial disaster." In other words, subsidies of whatever kind are dangerous expedients; the policy which is needed both locally and nationally is that which is based on accurate information, business acumen, courageous expenditure in the continuous acquisition of new knowledge, and the prompt application of such knowledge in overcoming the competition of rivals, whether at home or abroad.

Fermentation industries provide us with an example of potential development which will depend for its fruition on chemical research. The Scottish fermentation industry is, of course, severely handicapped by the extremely heavy excise duties on whisky and beer; moreover, public opinion and consequent legislation tend, and rightly so, to restrict its opportunities for expansion by discouraging the excessive consumption of alcoholic beverages. But alcohol is more than a beverage; it is a source of power and a substance from which numerous organic products may be derived. Therein lies its economic importance. As regards its use as a source of power the Government might well consider the suggestion that a minimum percentage of industrial alcohol should be incorporated in petrol; this action has indeed already been taken by a number of countries which have no indigenous supply of petroleum. So far as alcohol as a synthetic organic chemical is concerned, the report looks forward to the time when "the number of products made from ethyl alcohol and from other compounds obtained by fermentation may be almost as numerous as the progeny of coal tar". Let us hope that our fermentation industries and our agriculturists are fully alive to the implication.

Decline in the shale, textile, and shipbuilding industries in Scotland has affected the heavy chemical industry, which is primarily concerned with the production of raw materials for other manufactures, and tangible development is difficult to foresee. However, Scotland has had a large share of the explosives trade, gaining considerably by amalgamation of those interests. As a producer of leather she is in a relatively poor position, partly because most of the boots and shoes sold in Great Britain are made at Northampton or Leicester, and partly because she is largely dependent on outside sources for raw material. The patent leather industry is not carried on at all north of the Tweed, since in its early days lack of adequate sunlight for hardening the oil film militated against its establishment there; hence we are now dependent on Continental and American supplies The bleaching, dyeing, and calico-printing industry suffers from the Indian duties and boycott and from the growth of Japanese competition; "it seems unjust that Japanese goods should be admitted into any Empire markets on the same terms as British goods, while Japan imposes prohibitive tariffs against British goods in all territories under its control" The report on the rubber industry refers to the serious handicap of the tax on petrol and similar 'spirits' consumed in manufacturing operations, in the case of one Scottish concern a duty of 6*d*. per gallon adds £6,000 annually to manufacturing charges.

Iodine continues to be produced in Scotland, considerable quantities being still made from kelp at works in Falkirk and Clydebank, and it is interesting to note that there is one small works in England extracting iodine from kelp The amount obtained from this source is, of course, only a small proportion of the available supplies, most of which comes from Chile Again there is heavy competition from Japanese manufacturers who, not being members of the Iodine Convention, sell below Convention rates Other industries to which reference is made include those concerned with paints and varnishes, cement, chemical plant, barytes, coal, bitumen, wood and bone distillation, pharmaceutical products, food colours and flavourings, bichromate, firebricks, disinfectants, soap, etc

The pharmaceutical industry regards as necessary such regulations as have been imposed by legislation, but certain other industries complain of obsolete restrictions, while there is frequent reference to the need for cheap transport and amelioration of the burden of taxation It is suggested that Scottish manufacturers might exploit the goodwill which Scotland is said to enjoy in foreign countries by marking their goods "Made in Scotland". England, which owes so much to Scottish brains and Scottish character, will not begrudge any advantage which this delicate advertisement confers

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Modern Thermodynamics

Modern Thermodynamics by the Methods of Willard Gibbs. By E. A. Guggenheim Pp xvi+206 (London: Methuen and Co, Ltd, 1933) 10*s* 6*d* net.

IT is an almost universal experience that thermodynamics is harder to understand than ordinary dynamics. For whatever reason this may be, the consequence is that in the textbooks it has not acquired the same standardised routine of development as has dynamics, but is treated from a great number of different angles As its title suggests, the present work uses the manner of Gibbs, but it takes advantage of the great advances that were consequent on Gibbs's work to bring the subject up to date The author has achieved a very high degree of success in his intention, and it is perhaps not too much to say that the book possesses not only the virtues, but also some of the defects of the great classic on which it is based. This criticism is not intended to belittle the book, which has much of the same classical character as its original; a cynic once said that a classic may be a great book, but that it is often one that is too dull to read, and though the saying is inappropriate here, still some readers may feel a faint echo of the sentiment, just as they would in reading its prototype. The resemblance of the two is in many ways very close, thus Gibbs never explains the elementary parts of the subject and nor does Guggenheim, though he is kinder than his predecessor in that he gives references for them to books which make entirely satisfactory introductions

Having got his basis, the author proceeds in the same leisurely and systematic manner as did Gibbs to develop all its consequences; everything is simple and straightforward, and the only trouble is the same as that which must have assailed many of Gibbs's contemporaries, the feeling 'It is all very nice, but what is a chemical potential anyhow?" In those days this was inevitable as no chemical data existed to illustrate the subject, but in view of the work of G N Lewis and others, the matter is very different now and it would have been quite possible to give detailed numerical examples to illustrate all parts of the subject. Granted that to do so would have rather diminished the resemblance of the book to its prototype, yet the departure would have been a material help, and it is surely no part of the tribute of reverence we should pay to a great work to insist that the difficulties under which it was written should be imitated

As to the details of contents, the book begins with a short account of foundations The author makes a very just comparison between thermodynamics and dynamics, in dynamics the beginner learns the subject starting with Newton's laws, but for more advanced work a new foundation is made with the help of Least Action. This is usually preferred by the expert, but would be useless for the beginner, and the present work is to be likened to the more advanced type in dynamics. There is no explanation of entropy, it is regarded as a primitive idea like temperature This seems an admirable plan, but it is incompletely worked out, since the consequence must be to degrade energy to some less primitive position, for otherwise there would be three primitives instead of the usual two However, nobody ever agrees about foundations, and the only generalisation about them that holds (and even this will command almost universal dissent) is that though they are things one cannot do without, the exact form of them is a quite unimportant matter of taste

In the second chapter the author develops all the general differential relations of the subject, and a most attractive feature is that everything is systematically done for all four forms of the thermodynamic potentials, instead of allowing one of the four, the internal energy, to have its usual but unmerited position of privilege After this, the author proceeds to build up the whole of chemical thermodynamics, starting with systems of a single component, and then treating of gaseous mixtures, and so arriving at his main subject of solutions These he classifies into ideal, semi-ideal and non-ideal, and the special discussion of the intermediate type will probably be found a most useful simplification of the subject Making a cross-classification in another chapter, he discusses solutions from the point of view of their diluteness Altogether, solutions are very fully treated, the original ideas of Gibbs being supplemented by the fruitful conceptions of fugacity, and of activity and osmotic coefficients, which have been brought to the fore by Lewis and others These conceptions have served to make the dry bones live, our only criticism of their discussion here is that the bones are discussed as they would be in a work on theoretical anatomy, rather than as in one on natural history

Then there are chapters on electro-chemistry (but not including thermo-electric phenomena), and on surface phases, this last includes not only the thermodynamics of surface tension, etc, but also the quite different subject of such surfaces as grease films on water, which were unknown in Gibbs's day There follows a very short chapter on radiation, which tells too little or too much, for it gives Stefan's law, but not that of Wien. The final chapter goes outside the field of classical thermodynamics and gives a short account of the so-called third law, and of chemical constants. The author adopts the necessary data from statistical theory, wisely avoiding much explanation, and illustrates the results by good short discussions of many of the substances for which the chemical constant is known; in this particularity he advantageously departs from the rather too abstract method of the purely thermodynamical part of the book

It will be seen from the above that the book is not to be regarded as an introduction to thermodynamics It will find its use partly by the mathematical student who wants everything set out in an orderly and systematic manner, and partly by the physical chemist who wishes to see how his more specialised ideas can be fitted into the general scheme Altogether, it will be found a most useful work of reference for the general theory of chemical thermodynamics. C G D

Richard Trevithick

Richard Trevithick · the Engineer and the Man. By H W. Dickinson and Arthur Titley (Trevithick Centenary Commemoration Memorial Volume) Pp. xvii + 290 + 18 plates (Cambridge: At the University Press, 1934) 10*s* 6*d* net

IN William Walker's well-known group of British men of science alive in 1807–8 there is no more romantic figure than that of Richard Trevithick, who at that time was struggling with the problems of steam transport by road, rail and river and was also endeavouring to bore the tunnel known as the Thames Archway beneath the Thames between Limehouse and Rotherhithe The latter was a project which Trevithick, with that buoyant optimism which was one of his characteristics, had undertaken, thinking "this will be making a thousand pounds very easey, and without any risque of a loss on my side" Entered upon without sufficient preparation and with inadequate appliances the scheme proved a failure, but Trevithick's position as the engineer of the concern had some share in making his name widely known and perhaps had some influence on Walker when choosing his portraits for the group of 1807–8. At any rate, we know to-day how well Trevithick deserved to be placed beside Watt and Telford, Brunel and Maudslay, Davy and Dalton

The outstanding feature of Trevithick's lifework was his application of the high-pressure steam engine In this direction he was a great pioneer and this at a time when the practices of Watt were looked upon by many as the acme of achievement Trevithick's early life was passed amidst the Cornish mines where Boulton and Watt's low-pressure engines working with steam at 2 or 3 pounds' pressure had saved many a mine from closing down Boulton and Watt, say the authors of this book, were "the greatest benefactors that Cornish mining has ever had" Where Trevithick got his revolutionary idea of making small compact engines without beams, air pumps and condensers, and circular wrought-iron boilers, using steam up to 50 or 100 pounds' pressure, we do not know, but he had already launched out in this direction before the patent of Boulton and Watt had expired

It would be a mistake to think of Trevithick as wholly absorbed by his engine work, for he was seldom content with only one iron in the fire and was easily lured aside from the main business of the moment Yet as can be seen from the chronology given by Messrs Dickinson and Titley in this admirable 'Life' of Trevithick, the high-pressure engine ran as a connecting thread through his whole career In 1797 he made models of stationary and locomotive engines, in 1798 he constructed his first high-pressure winding engines, in 1801 his first steam carriage and in 1802, with Vivian, took out his great patent A year later, in 1803, he made his second steam carriage together with some stationary engines for Wales, in 1804 he constructed the Penydaran rail locomotive, in 1805 the Newcastle locomotive, and these were followed in 1806 by his steam dredger and in 1808 by his locomotive *Catch me who can* Overtaken by sickness and bankruptcy he then returned to Cornwall, where during the years 1811–1814 he made high-pressure pumping engines, agricultural engines and engines for the Peruvian mines for which low-pressure condensing engines were unsuitable It was his work for the Peruvian mines which opened to him the prospects of wealth and led him in 1816 to sail for South America. That great adventure, of which we would know more, failed through causes beyond his control, and when eleven years later he returned home, his sole possessions were "the clothes he stood in, a gold watch, a drawing compass, a magnetic compass, and a pair of silver spurs" As always, however, he faced the situation quite undaunted, and to his later years belong those flashes of genius of which the authors write so sympathetically in the sixth and last chapter of their book

Of Trevithick's upbringing, his environment, his character and abilities, his generosity and want of prudence, his fertility of invention, his thoughtlessness in domestic affairs, his triumphs and his failures, each must read for himself He was no ordinary man and had some of the attributes of a genius and a hero. Born in Cornwall in 1771, he died in poverty at Dartford in 1833, and last year his centenary was commemorated in a worthy manner To that commemoration we owe the publication of this book The Commemoration Committee deciding to publish a memorial volume, Messrs Dickinson and Titley generously offered their partially completed work and it was accepted Funds, however, not being forthcoming in sufficient amount to pay for its printing, Messrs Babcock and Wilcox, Ltd undertook to bear the cost of publication as their special contribution to the Centenary Fund In these happy circumstances the book now makes its appearance in a style worthy of the publishers and at a price at which no one can cavil It is admirably illustrated and besides the chronology and the six chapters dealing with the various stages in Trevithick's career, there are appendices dealing with his memorials, his patents and his descendants It is certainly one of the best that we know of engineering biographies

The Werewolf

The Werewolf By Montague Summers Pp xiv + 307 + 8 plates (London Kegan Paul and Co, Ltd, 1933) 15s net

THERE are various ways of approaching the problem of the occult, as has been shown in the literature on witchcraft which has appeared in the last decade The fashion of a previous generation which regarded it as a mere superstition of the Dark Ages, happily, has passed away in favour of a more rational attitude such as that of the anthropologist, who seeks to relate the belief to the magical and religious practices of primitive peoples, as an accompaniment of a phase in man's development, or of the psychologist, who seeks to derive an explanation of magical phenomena from mental aberration

The belief in the werewolf, the 'man-wolf', who puts on an animal form and preys on his fellow men, which was current in medieval Europe and survived down to modern times, is thus regarded either as of a piece with the belief of primitive peoples in the possibility of 'shape-shifting' and, generally, as belonging to their attitude towards animals as in some way uncanny , or, alternatively, as based upon misinterpreted observations of perversions, such as necrophany and lycanthropy, or forms of hysteria and delusional insanity, to which the social and economic conditions of the Middle Ages rendered the populace especially prone.

Mr Summers confines his study of the werewolf to its occurrence in Europe, passing over in a brief reference the werelions, tigers, hyenas and leopards of primitive peoples. He also includes in this class the fox belief of China, strictly speaking, this is not a werewolf belief, but its contrary, for the Chinese fox spirit turns into a man or possesses a human being and not vice versa Mr Summers deliberately sets aside the evidence from primitive peoples and he rejects the anthropological point of view in favour of the theological, to which he regards anthropology as merely ancillary Hence the belief is treated from the angle of Catholic orthodoxy, and apart from chapters dealing with the records of cases of the werewolf in the various European countries, discussion is confined to the opinions and rulings on the subject of the werewolf of writers on witchcraft and magic in the Middle Ages and immediately succeeding centuries Mr Summers has an intimate and extensive knowledge of this literature, and his careful analysis and full quotation from the authorities provide a mass of information on this aspect of medieval thought, as well as a useful guide for the use of those who wish to pursue the subject further

The werewolf in theological argument was regarded as closely allied to the witch , both were believed to derive their powers from a pact with the devil. As the object of the change of form into a wolf was to prey on human beings and devour their flesh, the werewolf was also closely related to the vampire. Hence it is not surprising to find that the werewolf belief flourished in eastern Europe, the home of the vampire , and there both beliefs still survive. Russian peasants to-day think that Lenin for a time was a bear. Here they are in agreement with their forerunners, for in the sagas of northern Europe, the animal form assumed was the bear, and the prevalence of the belief is shown by the familiar expression 'bersork' It is well known that this peculiar relation with the bear still holds among the primitive tribes of northern Asia across to the Far East, where it takes the form of the bear cult, with which the writings of Sir James Frazer have made us familiar It is unnecessary to look further for an analogy upon which to base a suggested origin for the werewolf type of belief , but this Mr Summers would be precluded from admitting as relevant by his theological prepossessions

Medieval theologicians, not having the advantage of a Sir James Frazer to assist their speculations, were faced with the dilemma of either denying a fact accepted as such by the Church, or supporting an opinion dangerously like a heresy in attributing an act of creation to a power other than God Their subtle arguments and skilful evasion of the difficulty leave the reader to ponder the nice problem of the conflict between authority and scientific evidence, which Mr. Summers solves by whole-hearted acceptance of the former.

Short Reviews

Wundkompensation, Transplantation und Chimaren bei Pflanzen. Von Prof N P. Krenke. Übersetzt von Dr N. Busch Redigiert von Dr O Moritz. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 29.) Pp. xvi+934. (Berlin · Julius Springer, 1933.) 89 80 gold marks

THIS extensive work first appeared in Russian in 1928 under the title "The Surgery of Plants" The German translation has been edited and brought up to date with the aid of the original author It is a thorough-going treatment of growth reactions following wounding and the phenomena connected with transplantation and grafting from a causal point of view Regeneration is considered from every aspect, including chromosome multiplication, hormones and the theory of mitogenetic rays. Many teratological phenomena find here a causal explanation A considerable amount of modern cytological and genetical work is brought to bear on these problems, and the early but often forgotten work of Darwin is extensively and aptly quoted.

A well-illustrated section of 240 pages deals with the formation and structure of chimæras, a field in which Prof Krenke has made extensive studies. The whole subject is treated in a way which will throw further light on their nature. The last section deals briefly with the introduction of foreign substances into plants and acquired immunity.

The extensive bibliography includes many Russian papers which might not otherwise be known in other countries. Notwithstanding the usefulness of this work, the price appears inordinately high even although two coloured plates of chimæral *Solanum* fruits are included

R R. G.

The Cult of the Goldfish. By T C Roughley. Pp xiii+146+29 plates (Sydney Angus and Robertson, Ltd ; London Australian Book Co., 1933) 6*s* net

MR. ROUGHLEY has written perhaps the best book on gold-fish culture that has yet been published It is a most useful volume, well produced and full of interest from beginning to end The author thoroughly understands his fish and shows how they will respond to considerate treatment Those who read these pages will never wish to keep a gold-fish in a bowl again, but they certainly will wish to keep a real aquarium and care for the fish in it , moreover, directions are given for making the aquarium or pond at home, which must appeal to many craftsmen

The varieties of gold-fish are numerous and new kinds are constantly appearing Breeding gold-fish is an exciting occupation and apparently not so very difficult if care be given to essentials The aquarium made, one is taught how to supply it with suitable plants The varieties of gold-fish are discussed and their food, also which animals may be put in with them to advantage and which should be avoided There are chapters on spawning and development, the garden pool, animal pests in ponds and diseases of gold-fish.

Not only are the life-histories of the food animals discussed, but also those of the diseases to which the fish are subject and of those animals which may be found in the pond Thus the mosquito is useful as the larvæ are a good food, pond beetles and dragonflies are harmful, the larvæ eating the young fishes The information given on the diseases which so often affect gold-fish is extremely interesting and full remedies are discussed

Virus Diseases of Plants By Dr John Grainger Pp viii+104+6 plates (London Oxford University Press, 1934) 6*s* net

OUR knowledge of the plant viruses has increased enormously in the last decade We have not yet, however, arrived at any definite conclusion as to the nature of this interesting group of pathogens In this book, the whole problem of virus diseases and their etiology is compressed into seventy-five pages, with, in addition, twenty-five pages of bibliography The first chapter is devoted to a very short account of the general subject. The second deals with the relation of the virus to its host plant—with special reference to some of the better known viruses It is not quite certain that the suggestions in the section on cytology, that a 1/12 in oil immersion lens is necessary for the examination of the *X*-bodies and that these bodies frequently disappear by the erosion of the protoplasmic stream, would meet with general acceptance among cytologists Chap. iii is devoted to the physical and chemical properties of the virus so far as these are known. The fourth chapter deals with the important problem of the insect transmission of the disease and gives some meagre notes on the treatment of insects under experimentation The chapter on the economic effects and the control of the disease is probably the most useful in the book It deals with methods for preventing the spread of the disease The classification and description of virus diseases is dealt with in chap vi

This book will be of use mainly as a general account of the plant virus problem

Celtic Ornament in the British Isles down to A D 700 By E T Leeds Pp xix+170+22 plates (Oxford Clarendon Press , London Oxford University Press, 1933) 12*s* 6*d* net

IN this study of Celtic ornament, Mr E T Leeds has elaborated a communication presented to the first International Congress of Pre- and Protohistoric Sciences in 1932 It is a survey of the subject as a whole from the earliest appearance of distinctively Celtic art after the coming of the early Iron Age peoples to Britain down to the beginning of Anglo-Saxon times The various types of characteristic motifs are traced in the finds from initiation to decay and their relations and distributions analysed Such detailed discussion was eminently desirable, as nothing of a similarly comprehensive nature had been attempted since Romilly Allen's work on Celtic art in pagan and Christian times of more than thirty years ago In the meantime, not only has the material which Allen had before him come to be more clearly understood, but also much new material has accrued, bringing with it a clearer appreciation of the problems which call for solution Mr Leeds's views on the renaissance of Celtic art after the Romano-British eclipse, especially when they differ from those of Mr T D Kendrick, will repay careful consideration

Neurological Effects of Syphilis Diagnosis and Treatment By Dr B Buckley Sharp (Oxford Medical Publications) Pp v+92 (London Oxford University Press, 1933) 7*s* 6*d* net

DR B BUCKLEY SHARP has provided us with a very interesting book on neurosyphilis , but it might very well have been larger There are several statements with which we are inclined to find fault To state categorically that "there are no clinical entities exclusively syphilitic" is a misstatement There is no better-defined clinical entity than general paralysis, which is in 100 per cent cases exclusively syphilitic Again, vascular lesions are present in certainly 80 per cent of neurosyphilitics

The author appears to be prejudiced in favour of including intracisternal salvarsanized serum in treatment, for he says he and Purves Stewart have never seen a return to a normal fluid without using this treatment This is not the experience of the majority. The section dealing with diathermy might well have been expanded, a large amount of work has been done on this form of treatment. A 2 gm dose of tryparsamide is just as satisfactory as 3 gm and much safer.

The Drinking Habits of Birds

By SETON GORDON

THE lover of birds who places a shallow dish of fresh water each morning beside the bird table and has the pleasure of seeing chaffinches, robins and other of his bird friends drink eagerly from it, may perhaps have wondered how young birds in the nest receive the moisture which is necessary to them, or how sea-birds drink

I do not think that the young of any British birds actually drink in the nest, they receive their moisture in the food which is brought them, and it is partly no doubt because they cannot drink that the parents are so careful to shield them from the direct rays of the sun before they are feathered It is not perhaps generally known that direct sunlight is fatal to young birds The gannet is one of the hardiest birds, yet I have known a young gannet succumb after being left unattended in the nest for the space of rather more than an hour while the strong August sun beat down upon its small, black, naked body Even the golden eagle, which leaves its eaglets unprotected to the snow-laden wind, builds its eyrie almost always where the nest faces north and thus is sheltered from the sun During a recent early summer, my wife and I watched almost daily for the space of a fortnight at an eagle's eyrie from a heather hide The eyrie was facing north-east, and the sun did not shine on it after eleven o'clock in the morning One morning after a very cold spell the sun shone strongly on the eyrie The morning had been dull and close, and when the sun, shortly after half past ten, suddenly emerged from one of the heavy clouds, its rays were brilliant and for once I felt comfortably warm in my hiding-place The mother eagle was standing at the edge of the eyrie, and when the sun appeared walked over to the eaglet (which was three weeks' old and covered with thick white down) and, standing between it and the sun, slightly opened her great wings to shelter it The sun increased in power, and gradually, in three distinct movements, she spread her wings to their fullest extent and stood quite motionless The beauty of that picture I shall long remember My peep-hole was not more than twelve feet from the nest, and every feather of the eagle was distinct, the great wing primaries drooping to the sides of the eyrie The sun gradually left the eyrie and when the nest was in shade the eagle folded her wings, walked to the edge of the eyrie and launched herself on the air with a sudden splendid gesture.

The young golden eagle is hatched early in May and does not take its first flight until mid-July. During all that time it never drinks, but depends for its moisture on the food brought to it—hares and grouse, rabbits, even stoats and squirrels But does the adult eagle drink ? Some observers believe that it never does so, but a stalker told me that he once came suddenly on a golden eagle bathing, if not actually drinking, in a clean pool of a hill burn, and in his words "when she had finished bathing herself she walked to the edge of the pool and shook out her feathers just like an old hen"

There may be quite a number of our land birds which do not habitually drink, and what of the great army of sea-birds that live their whole lives on the salt water ? Do they drink sea-water ? Or do they never drink ? I do not refer to the sea-gulls, which spend a part of their time on land, but to the vast armies of guillemots which crowd the rock stacks in summer as they incubate their eggs on arid sunbaked ledges, to the colonies of razorbills, cormorants and shags, to the storm-loving petrels and the gannets which fly tirelessly a hundred miles and more to catch a fish for the hungry family The only water which all these birds know is the salt water of the ocean Do they drink it or does their fishy food, saturated with moisture, supply them with liquid enough ? Even if they do not drink salt-water, they must have some means of dealing with their food, which is salt-impregnated, and would probably be fatal to a land bird All who know the great northern diver, the guillemot, the black guillemot and other divers of the sea must be familiar with the habit of all these birds of dipping the bill constantly into the water after a dive and also when swimming This is done whether the bird has caught a fish and swallowed it, or whether the dive has been unsuccessful, so that it cannot be to clean the bill The impression given superficially is that the bird is drinking, but I am rather inclined to believe that it is a habit, perhaps originally adopted when cleaning the bill It is interesting to note that when human inquirers approach a nesting place of a pair of black guillemots the birds swim rapidly backwards and forwards, calling shrilly and repeatedly dipping their bills in the water

There is one exception to this habit of bill-dipping among the divers of the sea The puffin does not dip the bill, although it is as assiduous a fisher as any. Perhaps it is because its bill, being large and clumsy, would offer too great a resistance to the water through which the bird is swimming It can, I think, be safely concluded that this curious habit of holding the bill just beneath the surface of the sea while swimming has nothing to do with drinking

Sea-gulls, although they pass much of their time on the sea, leave it when they wish to bathe and drink There is one small loch beside the Atlantic where gulls are almost always to be seen bathing with relish, and they fly backwards and forwards between this loch and the sea, perhaps several times a day.

The wild whooper swan which arrives in Britain in autumn from Iceland settles at times on the sea, but is never happy on the salt water, although its relative, the smaller Bewick's swan, passes most of the winter season on the brackish lochs and estuaries of the Hebrides Ducks appear to drink frequently, but wild geese at their winter haunts must be able to go some time without water, for some of the sea-girt isles where they live have no fresh water upon them

The grey or hooded crow is detested by game preservers because of its habit of stealing eggs Especially when the grey crows have young in the nest they hunt far and wide for the eggs, not only of grouse but also of much larger birds, and I have known them suck a nest of a grey lag goose's eggs in a single day. It is possible that this egg stealing is partly to provide the young birds in the nest with as much liquid food as possible, and one can understand why young hooded crows should be able to exist without water But the twite, which feeds its young on seeds, the siskin, the linnet and other passerine birds—how is it possible that the broods of these birds should live without water during their time in the nest? The passerine birds which feed their young on hard and dry seeds do so by regurgitation They swallow the seeds, and later present them to their young moistened, and impregnated with their digestive saliva Those which feed their young on insects and other juicy living food feed them directly, without regurgitation

Dr. Glover Allen, in his book "Birds and their Attributes" referring to the drinking habits of North American birds, writes .

> "In the far north water may be unobtainable throughout winter, but it may be possible for northern birds to subsist on snow I have known pine siskins to eat snow and once watched a flock of Cedar Waxwings engaged in catching snowflakes during a storm, flying up and snapping at them as if they were insects Here is a subject on which more information might easily be secured "

Elsewhere Dr Allen remarks ·

> "A final word as to the drinking habits of birds, which have not perhaps been sufficiently studied. We have all noticed that hens and sparrows sip from a pan, raising their head between each sip as if to let the drop trickle down their throats The quite different manner in which pigeons thrust in their bills and pump in the water like a horse cannot have escaped the attention of most We do not know much as to the amount of water birds need and how often they drink It is said that prospectors in desert country are often able to locate springs by watching the flights of doves or pigeons which must drink daily and fly in from the surrounding country regularly for the purpose
>
> "Most sea birds are known to drink salt water in preference to fresh, indeed captive gulls may die without it Land birds, however, need fresh water No doubt some species must go long periods without drinking, as in case of certain birds that incubate continuously, for example, the female Hornbill that is walled up in her nest cavity and fed by her mate "

In "Jungle Side", a natural history account of Ceylon, by John Still, are some interesting remarks on the drinking habits of birds. The author writes .

> " the lovely paradise fly-catcher who nests in some garden in the nor'-east monsoon can be found passing the sou'-west as a visitor to a water-hole. Others are permanent forest dwellers, like the wonderful long-tailed robin whose song is the sweetest in all Ceylon, and another rather rare little bird who often owns a water-hole to himself, the three-toed kingfisher, whose gay habit it is to have rosy plumage where most of his tribe have blue "

Observations by trained watchers on the drinking habits of birds are, however, very meagre, and the whole fascinating subject would certainly repay more close observations

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Joachim Barrande and his Palæontological Work

By JAN KOLIHA, Curator of the Barrandeum, National Museum, Prague

A LITTLE more than fifty years ago, on October 5, 1883, the death occurred of Joachim Barrande, who was one of the greatest palæontologists of the second half of the nineteenth century. Barrande was born on August 10, 1799, on the estate of his family at Sangues (Dept. Haute Loire). He studied at the Paris Polytechnic School Besides lectures of a purely technical nature on bridge- and road-construction, he attended those on geology, zoology and botany. His teachers were G. Cuvier, A. Brongniart, de Jussieu, C. Prévost, de Blainville, G. St. Hilaire, Serres, Audouin and others.

Soon after Barrande left the Polytechnic, he was called to the French Court, to act as tutor in natural science and mathematics to the hereditary Prince Henri, Count Chambord, grandson of Charles X When the Bourbon family was expelled from France, after the revolution of July 1830, Barrande also went into exile with them. After a short stay in Edinburgh, the royal family came to Bohemia, first of all living at Buštěhrad Castle (west of Prague) and then at the Castle, Prague (that is, Hradčany, the old royal castle of the Czech kings) From this time onwards, Barrande remained permanently in Prague.

In 1833 Barrande gave up his position as a tutor, and devoted himself to engineering. He was entrusted with the surveying of a projected line, which was a continuation of the horse route, from Křivoklát, along the River Berounka, to the coal basin of Radnice and then on to Plzeň.

During this work, Barrande found a number of beautifully preserved fossils, in Middle Cambrian shales, in the neighbourhood of Skryj and of Tejřovice. By these discoveries he confirmed his view, that strata exist in Bohemia similar to those which Murchison had studied in Wales and Scotland. When the first part of the latter's "Silurian System" appeared in 1839, Barrande decided to investigate systematically all the so-called Transition Strata and their fauna in Bohemia, being certain that the Silurian formation of Bohemia was the same as that in Britain.

Finally, after many years of investigation and collection, Barrande began the publication of his "Système silurien de la Bohème" (1852), a work which even to-day is the only one of its kind in palæontological bibliography. The author published between 1852 and 1881 twenty-two big quarto volumes, partly containing text, partly plates. The treatise contains more than 6,000 pages of descriptions and 1,160 plates of fossils. The first volume, in which he deals with trilobites, forms, together with the supplementary parts, the most important and best account of these extinct crustaceans in general. Barrande also gives a careful description and illustration of the geological conditions in the older Palæozoic rocks of Bohemia. He divides the "Silurian" into eight series, indicated by the letters A to H. He determines the order of succession, the relations of deposit, and the fossiliferous contents of all his stages, based on their palæontological connexion with the British Silurian. In this and in the following volumes of his work, the author describes in turn the other crustaceans besides trilobites, and the fishes, cephalopods, brachiopods and lamellibranchs known up to that time in Bohemia.

It is clear from his palæontological work that Barrande was a convinced believer in the constancy of species (being a pupil of Baron Cuvier), and therefore an opponent of the theory of evolution. It is well known that his objections were among the most weighty of those which were ever expressed against that theory.

While issuing his chief work and several lesser publications, Barrande spent much time in defending his theory of so-called 'colonies', which were supposed to be intercalations of parts of a later geological fauna in strata containing an older geological fauna, the result of migrations. Barrande, from 1861 until 1881, was at war with many well-known geologists, and to the day of his death was never shaken in his opinion of such migrations of faunas. He defended his view by the publication of polemical articles, letters and longer works, which were gathered into five parts and entitled "Défense des Colonies". The chief opponents of Barrande's views were Prof. J. Krejčí, the father of Bohemian geology, V. M. Lipold, the Viennese geologist, and J. E. Marr, the English geologist, who explained these phenomena as due to faulting of the strata.

Barrande also took part victoriously in the dispute concerning the independence of the so-called Taconic System in North America, ending a discussion of many years by proving that the fauna which was discovered by Emmons and Marcou represented his primordial Cambrian fauna.

Meanwhile, great uncertainty prevailed both in the Bohemian National Museum and in the Czech University as to what would be the fate of the huge collections of fossils made by Barrande. Various negotiations took place, letters were written to Barrande, and a promise was obtained that his collections would be installed in the new building of the National Museum. When Barrande's will was opened, it was discovered that the National Museum had become the heir of all his collections, of all his manuscripts, and of his scientific library. By this splendid bequest, the National Museum of Prague has become the owner of one of the greatest collections of older Palæozoic fossils, and as such is the most important goal of all geologists and palæontologists who study the oldest fossiliferous rocks.

Obituary

Prof. Sven Odén

It was with the deepest regret that we heard of the death of Sven Odén. He had for some time been in failing health, but his friends still clung to the hope that his vigorous vitality might win. Unfortunately this was not to be, and he died on January 16 in his forty-seventh year.

Odén was trained under Svedberg and was soon recognised as an exceptionally able colloid chemist. His first investigation, published in 1910, was on the coagulation of colloidal sulphur, and it brought out the important fact that small variations in the hydrogen ion concentration of the solution greatly influenced the critical concentrations of electrolytes that just brought about coagulation. This group of problems interested him throughout the whole of his life and he constantly reverted to it. In 1911 he began an important series of investigations on the size of the particles in the suspension, determining the mass of the particles lying between successive size limits. This led him to a study of fractional coagulation. All this work he pursued with great ingenuity, using as his materials such varied substances as clays, deep sea deposits, cements and various precipitated substances. Having an unusually wide outlook, he was able to apply his results not only to problems in the pure science of colloids, but also to problems of applied science.

Nothing better illustrates the genius of Odén for attacking a difficult problem than the automatic balance he made for use in sedimentation investigations. By its means he was able for the first time to construct curves showing the mass distribution of particles between any desired limits of size in a mixture of various sizes Readers in Great Britain are familiar with some of these curves, especially those in his paper in the *Proceedings of the Royal Society of Edinburgh* in 1911 on the size of the particles in deep sea deposits, and in the *Proceedings of the Royal Society* of 1924 when, along with a group of Rothamsted workers, his colleagues during a period of extended leave spent at Rothamsted in 1923, he developed more fully this automatic balance and worked out typical distribution curves for clay particles of different sizes The subject is discussed fully in Dr B A Keen's monograph, "Physical Properties of the Soil" Later work at Rothamsted showed certain unforeseen sources of error not yet overcome which detract from the strict quantitative interpretation of the results Whether they can be avoided or not, the work stands out as the first and best study of distribution of clay particles according to size

A second group of investigations in which Odén achieved marked success dealt with peat He began about 1916, and by 1919 was able to publish his monograph "Die Huminsäuren", one of the best that has ever appeared on that particularly difficult and elusive group of mixtures Applying for the first time the methods of modern physical chemistry to the black sticky mixture of humus substances soluble in alkalis and reprecipitated by acids, he gave for the first time definite proof that the so-called humic acid really is an acid and he was able to assign to it fairly definite properties including tentative molecular and equivalent weights Considerable discussion has followed, and there has been in consequence of his work much clearing up of a very involved subject In addition to these physico-chemical investigations he also studied the possibilities of obtaining fertilisers by the use of peat its use as a source of ammonium chloride and for rendering mineral phosphates soluble

Another investigation in organic chemistry made by Odén, in conjunction with E Fischer, was the synthesis and study of sugar derivatives having molecular weights ranging up to 8,000

Up to this time Odén had been working at Uppsala, first (from 1913) as lecturer in chemistry, and later, in 1920, as professor of inorganic chemistry at the Technical Institute of Engineering In 1925 he became head of the Chemical Department of the Central Experimental Agricultural Station, Experimentalfältet, which post he held until his death Here he turned his attention to the exchangeable bases in the soil, which he studied by electrodialysis His last papers were on the application of electric light to the furtherance of plant growth, and the relations of certain organic compounds and the growing plant

Odén was not only a brilliant investigator but also a delightfully human personality, a man one loved to meet and talk to, full of ideas, overflowing with energy and vitality Whatever he touched he illuminated, and the more difficult the subject the more it attracted him and stimulated his inventive powers Sweden has lost a distinguished son and science a brilliant worker.

E J RUSSELL.

DR LILIAN CLARKE

THE death of Dr Lilian Jane Clarke, at the age of sixty-eight years, marks the passing of the pioneer of the best modern methods of the teaching of botany and Nature study in schools The subject early attracted her and having gained the gold medal of the Apothecaries' Society for botany and entered University College, London, in the session 1887–88, she took her B Sc degree in 1893–94, after studying botany under Prof F W Oliver She was appointed science mistress at James Allen's Girls' School, Dulwich, in January 1896, and from that time onwards devoted herself whole-heartedly to developing her own ideas of botanical teaching

The 'laboratory' Dr Clarke found in 1896 at James Allen's was a tray of apparatus on the hall platform, the laboratory she left was a well-equipped building for botany and other scientific subjects, with a greenhouse for biological experiments, and a large area of land laid out in the botanical gardens for which the school is justly famous, and with which Dr Clarke's name will always be associated These gardens started with a few natural order beds, but as her method of direct teaching of Nature study was developed, more land was gradually acquired for the study of plant physiology and ecology At first the financial difficulty was great, but eventually the value of the gardens was recognised by a small grant which permitted further extensions. The work throughout was done almost entirely by the voluntary labour of the school pupils in their spare time, and with their aid Dr Clarke built up a range of gardens unparalleled elsewhere Order beds, plots for genetical and physiological experiments, shingle bank, bog garden, pond, a lane with its hedgerows and even an oak wood were all finally acquired, and provide a wealth of material for teaching purposes The value of her pioneer work in this direction was recognised in 1902 by the award of the degree of D Sc (Lond), and in 1905 she was one of the first women admitted as a fellow of the Linnean Society

Somewhat of a martinet in her laboratories, Dr Clarke instilled habits of carefulness and accurate working into her pupils, which many of us have since fully appreciated The secret of her success was unbounded enthusiasm and driving power, coupled with the ability of interesting individual students in particular details of the work, making even the drudgery appear worth while Compulsory retirement under the age limit went sorely against the grain, but to the end she maintained her interest in the work of James Allen's School and of many of her old students, whose careers she followed closely.

As secretary in 1921–26 of the Education Section of the British Association Dr. Clarke did further work for the improvement of teaching methods; she was also chairman of the committee on the teaching of general science in schools, with special reference to the teaching of biology.

Apart from her botanical work, Dr. Clarke had a wide knowledge, and love for, Old London, and only two years ago she founded the London Wanderers Club among old J.A.G.S. girls, herself acting as leader on periodical rambles, sparing no time and trouble in their successful organisation. The esteem in which she was held by her old students was marked last year by the foundation of a "Lilian Clarke" botany prize fund at James Allen's School, and no more fitting tribute to her memory could be raised than an extension of this fund for the further encouragement of the subject for which her life was spent Her affection was fixed on Dulwich, and by her special request the first part of the funeral service was held in the old College Chapel, in the presence of the upper school and her friends and colleagues.

WINIFRED E BRENCHLEY.

MR R. J. MOSS

THROUGH the death on January 27 of Mr. R J Moss at the age of eighty-seven years, the Irish scientific world has lost one of its last links with the brilliant period of which FitzGerald was the leading spirit Moss was appointed keeper of the minerals and analyst to the Royal Dublin Society in 1875, and registrar in 1878, a position which he held until his retirement in 1921 He was the oldest member of the Royal Irish Academy, having been elected in 1874

Despite his onerous routine duties, Moss published many original papers, chiefly on chemical subjects Among these may be mentioned those on cobalt chloride as a moisture test, on an improved method of determining the gases dissolved in water, and on the state in which helium exists in pitchblende In the last he employed an ingenious method of extracting the helium by grinding the mineral *in vacuo* He also investigated some archæological problems His last paper, read before the Royal Irish Academy in 1926, deals with a chemical examination of some ancient metallurgical crucibles. From his analyses he arrived at important conclusions as to the metallurgical knowledge of the ancient Irish

Moss, however, like so many scientific men of his period, did not restrict his work entirely to one branch of science. His earliest work, carried out in collaboration with H. N Draper, dealt with the photoconductivity of the allotropic forms of selenium. He published papers on the spheroidal state and in 1896 investigated the effect of X-rays on the combination of hydrogen and chlorine and on the fluorescence of various salts

It is perhaps for his work in the foundation of the Irish Radium Institute that he will be longest remembered. When Joly first proposed his method of using radon in fine glass capillaries for therapeutic purposes, Moss designed and constructed the requisite apparatus. In this his skill as a glass-blower and his knowledge of handling small quantities of the rare gases were a great asset. The original apparatus was used for many years at the Institute. During the War he, and his two assistants Messrs. Stone and Deane, carried out all the work of the Institute, and large quantities of radon were supplied to various military hospitals, mainly for the treatment of wound scars.

To those who knew Moss only in his later years, one of his most striking characteristics was the extreme ease with which he carried their burden. To the last he was a valued member of the Irish Radium Institute Committee and a regular attendant at scientific meetings Of him, I think, we can use, in its best sense, the saying He, whom the gods love, dies young

J H J POOLE

PROF. T. ERIC PEET

WE regret to record the death on February 22 at the age of fifty-two years of Thomas Eric Peet, reader in Egyptology in the University of Oxford.

Eric Peet was educated at Merchant Taylors' School, of which in later life he became a governor, and at Queen's College, Oxford, where he was Jodrell scholar and graduated with second class honours in Classical Moderations and *Literæ Humaniores* In 1906 he was awarded a Craven fellowship and entered the British School of Archæology in Rome, later holding the Pelham studentship The results of his researches were published in 1909 in "The Stone and Bronze Ages in Italy and Sicily", a book which is still recognised as a standard authority

Peet then turned his attention to Egyptology, and this remained his principal occupation for the rest of his life He excavated in Egypt at Abydos, at first under Prof Garstang and then as assistant to Prof Naville, on behalf of the Egypt Exploration Fund, collaborating in vols 1–2 of the valuable memoirs on the cemeteries of that site He also collaborated in a publication on the inscriptions of Sinai A work entitled "Rough Stone Monuments and their Builders" appeared in 1912 In the following year Peet was appointed lecturer in Egyptology in the University of Manchester

After the War, in which Peet served with the King's (Liverpool) Regiment in Salonika and France, he resumed excavation in Egypt on behalf of the Fund at El-Amarna, publishing "The City of Akhenaton", vol 1 in 1923. His "Egypt and the Old Testament", a book of more general appeal than his other works, had appeared in 1922, and in the meantime he had also devoted attention to the study of papyri, more particularly those of a mathematical character, the result appearing in publications issued from 1920 onwards, dealing with the Rhind, Mayer and other papyri On Prof. P. E Newberry's retirement from the

Brunton professorship in the University of Liverpool in 1923, Peet was appointed to succeed him, and in the same year was elected Laycock student of Egyptology of Worcester College, Oxford. From that time onward Peet ceased to take an active part in field work, but devoted himself to teaching and research, also editing the *Annals of Archæology and Anthropology* (Liverpool) and the *Journal of the Egypt Exploration Society* His "The Egyptian Dynasty" appeared in 1930 and his Schweich Lectures, on "Comparative Study of the Literatures of Egypt, Palestine and Mesopotamia", in 1931. On the retirement of Prof F Ll Griffith from the chair of Egyptology at Oxford last year, Peet was appointed as reader, being also elected to a fellowship by his own college

At the very outset of his career, Peet was recognised as a brilliant archæologist, and at no time did his performance fall below expectation

WE regret to announce the following deaths.

Dr F A Bather, F R S, formerly keeper of the Department of Geology, British Museum (Natural History), on March 20, aged seventy-one years

Prof Davidson Black, F R S, professor of anatomy in Peiping Union Medical College and honorary director of the Cenozoic Research Laboratory, National Geological Survey of China, on March 15, aged forty-nine years.

Prof F Ll Griffith, emeritus professor of Egyptology in the University of Oxford, on March 14, aged seventy-one years

Dr Walter Rosenhain, F R S, formerly superintendent of the Department of Metallurgy and Metallurgical Chemistry in the National Physical Laboratory, on March 17, aged fifty-eight years

News and Views

Liquid Crystals

WE are publishing as a special supplement this week an account by Sir William Bragg, director of the laboratories of the Royal Institution, of those substances which in Great Britain are usually called 'liquid crystals' Their very striking appearances on the microscope stage are fairly well known, but this is the first time that a coherent story has been made of the optical principles by which their characteristic behaviour is exhibited The authors of even the most modern books on optics have not given this matter their attention, and until recently only superficial notice had been taken in Great Britain of this class of substance. The examination and explanation of their behaviour links them on one hand to the large class of oriented liquid films, and suggests on the other hand that more regular structure which X-ray analysis is daily revealing to us in so many directions By means of new photographs, diagrams and drawings of models, Sir William Bragg has with appealing directness given us a statement of the problems which these bodies have yielded The optical behaviour of the main groups is thus seen to be related to a varying degree of regularity of arrangement while in the mobile phase. Sir William's article, which gives a clear picture of the subject without going greatly into detail, will provide a stimulus to the growing interest which Friedel's 'mesomorphs' are attracting among physicists and others in Great Britain

Sir Robert Greig

SIR ROBERT GREIG, Secretary of the Department of Agriculture for Scotland, is about to retire from that position, as he attains his sixtieth year on March 23. He has only held the post for about five years, but that has been long enough for him to prove himself an excellent chief who has backed all scientific development in his Department. After leaving the University of Edinburgh, Sir Robert was for a time a ranch manager in north-west Canada After returning to England he was for two years lecturer at the Cheshire Agricultural College, passing on for four years to the Durham College of Science. In 1903–10 he was the Fordyce lecturer in agriculture at the University of Aberdeen In 1911 he returned south to become staff inspector in agriculture at the Board of Education, but not for long, for in the same year he became a commissioner at the Board of Agriculture, Scotland, of which body he was chairman in 1921–28. The combination of technical knowledge and administrative ability exemplified by Sir Robert goes far to explain his success, and general regret is expressed at his impending retirement.

Technical Officers and Administrative Posts

ON or about the same date that Sir Robert Greig retires, one of the four assistant secretaries of the Scottish Agriculture Department is also due to retire, in the person of Mr. H. M Conacher. It may almost be assumed that their successors will be Scotsmen, or there would be 'wigs on the green' at Westminster It is to be hoped also that on this occasion full consideration will be given to the claims of technical officers in Government departments to be selected for these posts, instead of assuming, as is usually done, that they cannot be capable administrators The functions of the Scottish Department of Agriculture are of a character which render technical knowledge and experience, in addition to administrative ability, highly desirable qualifications for the controlling posts. The Department's work is largely concerned with the scientific development of agriculture, the organisation of agricultural education, and the carrying out of schemes of land settlement. For these purposes it employs a variety of technical experts, and it is not too much to ask that senior members of these technical staffs should definitely be brought under review in the filling of the impending vacancies in the controlling posts.

Rothamsted Experimental Station

ROTHAMSTED must surely have appeared to most of its scientific visitors as the embodiment of stability, and it has come as a great shock to learn that its historic fields are threatened by the builder. When Lawes in 1889 set up the trust that governs the Station, he did not give the classical experimental fields or the land on which the laboratories stand, but only the use of them for a period of years. After his death it was found impossible to work the experiments without taking on the Home Farm from the family trustees, and this was done in 1911, but some of the highly important fields were let to Rothamsted on a six monthly arrangement only. Even so, the farm remained awkward and difficult to work, being split into three separate pieces, easy access to which was possible only by courtesy of the estate and the tenant. With the encroachment of the builder a new situation has arisen. The family is proposing to give up possession and to put the whole estate into the market. The situation has been closely examined by the Lawes Agricultural Trust Committee in consultation with the staff of the Ministry of Agriculture, and the conclusion has been reached that Rothamsted must own the land on which it is working. An appeal for £30,000 has therefore been issued over the signatures of an influential group including the Duke of Devonshire, the presidents of the Royal Society, the Royal Agricultural Society, and the National Farmers Union, Lord Clinton, the chairman of the Rothamsted Committee, Sir Daniel Hall, the late director and Sir John Russell, the present director of Rothamsted.

IT is greatly to be hoped that the appeal may succeed. The sum required is not large having regard to the area of land involved (515 acres) and to the fact that the purchase includes also Rothamsted Manor House, a Jacobean mansion, without which, it is understood, the land could not be acquired. Rothamsted has a record of more than ninety years to its credit; its first triumph was the discovery of the value to agriculture of artificial fertilisers, and of the way to make them on the large scale; it was on the Rothamsted fields that they were first tried on the large scale, with the result that the fertiliser manufacturing industry in various countries now has an annual output of some 35–40 million tons. It is not, however, because of past triumphs that Rothamsted deserves to survive. With a staff of some sixty scientific workers, it is an active centre of research on agriculture, soils, fertilisers, plant nutrition, statistical methods in biological science, plant pathology, entomology, and bees, while from its laboratories there has gone forth a steady stream of young men and women to take up high posts in practically all the more important agricultural research institutions in the Empire. Further, agricultural experts from all parts of the world go to work in its laboratories, to study its methods and its results. Its essential characteristics are the spirit of co-operation between the various departments which greatly facilitates border-land work, and the close connexion between field and laboratory, which it is now hoped to put on to a permanently secure basis.

Mr H. Dennis Taylor

THE council of the Physical Society has awarded the eleventh Duddell Medal to Mr Harold Dennis Taylor. This medal is given "to persons who have contributed to the advancement of knowledge by the invention or design of scientific instruments, or by the discovery of materials used in their construction". Mr Taylor has lived and worked in a period which must always be regarded as of the first importance in the development of optical instruments. The work of Abbe and Schott may be said to mark the beginning of the modern period in lens construction. At this time, Dennis Taylor was the optical manager of Thomas Cooke and Sons, of York, a firm celebrated for its astronomical and surveying instruments. Large astronomical refractors of that period suffered from a serious defect, the so-called secondary spectrum, a residual defect remaining when the normal conditions for the removal of chromatic aberrations have been satisfied. Taylor removed this defect by employing three glasses, and with rare skill and insight devised an objective in which not only the purely optical problem was solved, but also the important practical problems of giving accuracy of form to large lenses of different shapes, and allowing for their deformation in use. In these first triple apochromats, the colour correction is so good, and is so successfully combined with the other fine corrections needed, that the same instruments may be used both for visual and for photographic work. A number of large telescopes of this type are in regular use, among them two, of apertures 12½ in. and 12 in., at Cambridge; other 12 in. instruments of this design are in use at Rio de Janeiro and at Kodaikanal in India.

IN 1893 Mr Taylor took out two patents for photographic lenses, which were later put on the market as the well-known Cooke lenses. In the specifications of these lenses, nothing is more striking than the treatment of the theory which leads to the method of eliminating coma simultaneously with curvature and astigmatism. In later years Mr Taylor has not lost the skill and originality he displayed in his earlier inventions. Many of these fall outside the field in which physicists are specially interested. Mention should, however, be made of the telescope in which he showed that it is possible to combine a large aperture and a large field of view with freedom from aberrations comparable with that attained in the Cooke lenses. This is undoubtedly an achievement of the first order, and may prove of great value in scientific work. Mr Taylor has not only made outstanding advances in the construction of lenses, but he has also written a systematic treatise, "A System of Applied Optics", which will enable the physicist of the future to understand the scientific basis on which the art of lens designing rests.

Major John Wesley Powell, 1834–1902

THE centenary occurs on March 24 of the birth of Major John Wesley Powell, the distinguished American explorer, geologist and ethnologist. Born at Mount Morris, New York, of English parents who had emigrated to the United States in 1830, Powell was educated at Illinois and Oberlin College He served in the army during the Civil War, losing an arm at the battle of Shiloh, and in 1865 became professor of geology in the Illinois Wesleyan University at Bloomington Two years later he began a series of hazardous and important expeditions to the Rocky Mountains and the Green and Colorado Rivers, which led to a Government geographical and geological survey of the Rockies Powell served on this for several years and his reports, together with those of F V Hayden and G M Wheeler, were embodied by Clarence King in the United States Geological Survey bulletins In 1879 Powell was made director of the United States Bureau of Ethnology, and in 1881, on the resignation of King, he became also director of the Geological Survey He held the latter post for thirteen years, but retained the former until his death at Haven, Maine, on September 23, 1902 Powell was one of those pioneer geologists of the Far West, who as von Zittel said, "by their vivid portrayal of the work of subaerial denudation roused the intellectual life of the middle of the century to new conceptions on a grand scale "

The Electron in Electrical Engineering

MR C C PATERSON gave on March 15 the Faraday lecture to the Institution of Electrical Engineers, choosing as his subject "The Electrical Engineer and the Free Electron" It was the kind of lecture that one could have imagined Faraday himself to have given, consisting of lucid explanations and practical demonstrations of fundamental principles Mr Paterson stated that the science of electrical engineering was born again when the physicist showed how electricity could be liberated from metal In the free state it has potentialities of which no one dreamed before its discovery by Sir J J Thomson Just as physiologists learned that disease can be envisaged in terms of isolated germs and their life-history, so the physicist found that electricity can be thought of in terms of the individual electron, its habits and affinities Two of the main reasons for the practical usefulness of electricity are the ease with which it can be transported and the ease with which it can be controlled In the latter respect the free electron has now given the engineer new and extraordinary power Many applications have been already revolutionised and there are doubtless many more surprises in the future The secret is that a stream of free electrons, whether in a vacuum or a gas, can be manipulated with such facility that the electrical energy output can be reversed at the rate of millions of times a second Alternatively, it can be made to fluctuate at any given slow speed. While the agency which imposes this control on the electron stream is usually itself electrical, it is possible to control it by light, magnetism or heat

NORMALLY the electrons are confined within metal conductors When a portion of a circuit (a thermionic valve cathode or filament) is heated, electrons emerge freely, like water pouring through a porous section of hose pipe Heat is the agent which liberates the electrons from the interior of the wire. They swarm in a thin layer round the outside surface, ready to be attracted away by externally applied electrical forces exerted by another metal electrode As the electrons travel between the electrodes, the control causes them to flow or ebb, reverse or oscillate. Frequencies up to 3,000 million per second are attainable The photoelectric cell is another liberator of electrons In this case they emerge from a sensitised cold surface (cathode) where light falls on it, and are collected on the anode These cells are capable of receiving more than 300,000 impulses per second Mr Paterson explained and demonstrated the way in which sound and speech are reproduced in various devices He said that the electron often behaves as if it were a solid particle, but under other conditions it appears to be a group of waves It acts the same whether it has the particle or the wave characteristics In free space it acts like waves, but when it collides with something it has particle characteristics The filament of the incandescent lamp causes the electrons to crowd together and this heats it so much that it gives out light If the electrons escape from the filament its light-giving properties deteriorate, but if the gas envelope is filled with suitable gas mixtures, the escaping electrons collide with the gas atoms and produce a brilliant and highly efficient light source This is the principle utilised in luminous gas discharge tubes Cold cathode tubes need a high voltage to induce the electron stream, but a hot cathode produces a much more copious stream and enhances the brightness of the light Some of these luminous tubes produce twice as much light as an ordinary filament lamp taking the same power

Excavations at Ur

OWING to the late date at which excavations were resumed at Ur this year, Dr C L Woolley's first report on the season's work has only just been received and is published in the *Times* of March 16 The operations of the joint expedition this year are to be directed to the exploration of a cemetery of the Jemdet Nasr period of about 4,000 B C, which lies at a depth of 54 ft below the surface and involves the removal of about 5,000 tons of accumulated rubbish The three weeks' work which had been completed at the time Dr Woolley wrote has produced a remarkable example of sculpture in the round in the form of a woman's figure in alabaster with lapis lazuli inlay forming a fillet outlining the face, lapis lazuli and shell eyes, bituminous inlay for the eyebrows, which meet above the nose, and hair in dark paint The statue is ten inches high. It is not only the earliest known example of sculpture in the round at Ur, dating from about the last quarter of the fourth millennium, but it is also remarkable as being the first statue to be found in a grave It lay in a soldier's grave, close to his head and touching the blade of a bronze axe which he carried over his shoulder This grave is situated in what would appear to have been a military cemetery in the latter half of the Royal Cemetery period. This at least is the inference which Dr. Woolley draws from the number of battle axes, adze-shaped axes and daggers which have been found in this area. An interesting feature in the economy of the city is conjectured to interpret the existence in the very heart of the town of an area which throughout the history of Ur was a mere rubbish heap. A section shows that while this rubbish heap was continually receiving additions, it was at the same time constantly being removed to provide material for the terraces on which new buildings were erected.

Early Art at Giza

AN interesting account of the excavations of the Egyptian University at Giza during the present season is given by the Cairo correspondent of the *Observer* in the issue of March 18. The expedition, of which Prof. Selim Hassan is in charge, is engaged in investigating the Fourth Pyramid, with its surroundings, which has been identified as that of Khunt Kawas, daughter of Menkaura of the Fourth Dynasty. The exploration of the city attached to the pyramid, the only one of its kind yet discovered, has been carried further and has resulted in bringing to light, among other discoveries, the source of the water supply of the libation chamber and above the libation tank the tomb of an official described as "the purifier and prophet of the king's daughter". The temple of Khunt Kawas has been located adjoining the temple of Menkaura and has been cleared. The most notable of the finds here are the base of a diorite statue of the king Chephren, grandfather of the princess, and the torso of a sphinx and the body of a statuette of the king which lay in the entrance to the temple of the king. In a temple of Ankhtef, the priest of the king's *Ka*, were found two small white limestone statues which are said to be the most perfect examples of the statuesque art of the early period. They represent Ankhtef himself seated and a woman kneeling and kneading bread, which, it is thought, may possibly represent his wife. An almost equally notable specimen of this early art is the statue of a judge of the period, which shows remarkable power in the modelling of the muscles and limbs.

Empire Marketing Board Research Commitments

WITH the abolition last year of the Empire Marketing Board, considerable anxiety was felt as to the provision for numerous investigations, in progress and projected, hitherto financed by the Board. Some weeks ago, Mr. J. H. Thomas stated in a written reply to a question in the House of Commons that provision was being made for such investigations (NATURE, Feb. 17, p. 254). In reply to a question by Sir Arnold Wilson asking for more specific information, Mr. Malcolm MacDonald has given the following written answer: "The research schemes financed from the Empire Marketing Fund comprise agricultural and scientific research in the United Kingdom and also in the Dominions, India and the Colonies. It has been arranged for 39 of these schemes, representing an annual cost of approximately £200,000 in all, to be continued, in each case at the same research institution and with the existing personnel. Of these schemes 23 are in the United Kingdom, eight in the Dominions and India and eight in the Colonies. The sum of approximately £115,000 which is required in the next financial year from United Kingdom funds in respect of these schemes will be charged against Votes administered by various Government Departments in this country. The remaining £85,000 is being met by the Governments of the Empire or by the institutions or industries concerned."

Research Under the Agricultural Marketing Boards

IN a written reply to a question by Sir Arnold Wilson in the House of Commons as to what extent the powers conferred by both Agricultural Marketing Acts to adopt schemes for research in the production and marketing of agricultural products have been exercised by the Potato, Bacon, Milk, Pigs, and Hops Marketing Boards, Mr. Walter Elliot, Minister of Agriculture, stated: "The Hops Marketing Board does not possess any powers of the kind referred to. The other Agricultural Marketing Boards mentioned have certain powers which they may exercise in connexion with research services, but I understand they have not yet exercised them." Mr. Elliot said he had no doubt that the Boards in question will give attention to the question of research at the earliest possible opportunity, and that they will approach the Ministry of Agriculture should they think the Ministry able to assist them.

Wool Industries Research Association

THE report of the Council of the Wool Industries Research Association for 1933–34 refers to a 40 per cent increase in fees for private investigations as indication of the growing use which is made of the services of the Association by its members. Income from trade subscriptions has slightly increased, but an income of about £2,000 a year from the Empire Marketing Board has ceased. The activities previously financed by the Board are being continued and efforts are being made to obtain assistance from the Imperial Agricultural Bureaux. At a meeting of the Executive Council of the latter, it was emphasised that the work of the Association at Torridon should be concentrated on investigations of practical value to the grower and to the industrialist, and that Torridon should become a centre from which work on wool utilisation—both as regards research and educational publicity for the Empire as a whole—should emanate. Experiments on the nutritional influences on wool growth have continued in co-operation with the Rowett Research Institute, Aberdeen, and have revealed accentuated differences between a group of sheep fed on a maintenance ration and one receiving a simple supplement of high energy value. Arrangements have been made for further trials of experimental wool packs, including the impregnation of jute packs with rubber latex to anchor the jute fibres so that they do not stray into the wool during transit.

(*Continued on p.* 457.)

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Liquid Crystals*

By SIR WILLIAM BRAGG, O M, K B E, F R S

THERE are substances which are liquid in their mobility and crystalline in their optical behaviour The latter property suggests that there must be some degree of arrangement of the component molecules, and the former that this arrangement is readily disturbed though it may be as readily renewed Such substances are generally described as 'liquid crystals' It is argued, especially by Friedel, to whom we owe so much of our knowledge of their properties, that the title is bad, because the substances are neither perfect crystals nor perfect liquids Friedel would call them mesomorphs, which is much more logical, since the conditions to be described are intermediate between other conditions that are well known. The term 'liquid crystals' is, however, simple and suggestive, and those who use it are not likely to be misled

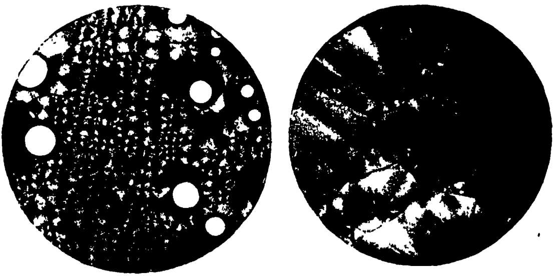

FIG 1 —Enlarged photomicrograph of a liquid crystal A Nicol prism is used as analyser there is no polariser The substance is ethyl *para* azoxybenzoate, temperature 114°–120° C Notice the polygons and the appearances of cones within them The white circles are air bubbles the grey portions are liquid The diameter of the original before magnification is 0 075 cm

The first to give any full and clear account of the properties of liquid crystals was O Lehmann[1] Following him, a number of investigators have attacked the general problem from various sides, Vorlander, Schenck, Friedel, Grandjean, Mauguin, Oseen and others Quite a large literature has grown up round the subject Friedel has given a full account of his experiments in the *Annales de Physique*[2] The present state of knowledge may be inferred from the account of the general discussion on liquid crystals and anisotropic melts held by the Faraday Society in April, 1933[3]

The characteristic properties of liquid crystals are connected with the peculiar form of their molecules These are relatively complicated structures possessing a common feature in their lengthy, chain-like form It is not surprising that such molecules should sometimes exist in a state intermediate between solid and fluid If the form and influences of a molecule can be represented approximately by a sphere, an assemblage of such molecules will resolve itself into individuals at some definite temperature. That is because all the links with neighbouring molecules are similar and break down together But when the molecule is relatively long and narrow, the linkages in different parts of it may be of different strengths Some may be broken at a lower temperature than others There must then be one or more intermediate states of greater but not complete mobility A sufficiently high temperature will bring about the dissolution of the remaining molecular associations, and then a truly liquid state is reached Though the intermediate phases lack the complete ordering of the crystal, that which remains has necessarily its optical effects

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* From the Friday evening discourse delivered at the Royal Institution on November 24, 1933

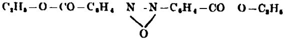
It is an important fact that the changes from solid to liquid crystal, and from liquid crystal to liquid, are as sharp and definite as the change from solid to liquid in the more general case

These optical effects possess in many cases a singular beauty, in respect both to colour and to form (*see* Figs 1, 12 and 13*) Most of them, but not all, can be explained in comparatively simple terms which, however, are rarely described in treatises on optics Writers have confined themselves to true crystals and true liquids, and the more complicated problem is discussed only in isolated papers. In what follows a brief account is given of this peculiar optics and of the consequent inferences as to the liquid crystal structure

SMECTIC CRYSTALS

Friedel divides liquid crystals into three classes in his own words, there are three mesomorphous phases The first of these he calls 'smectic', thereby implying a parallelism with the soaps Their special feature is their stratification In each layer the molecules are arranged side by side, like corn in a field, the thickness of the layer being the length of the molecules In the case of the soap bubble or film, we have such layers forming the surface inside and out The side to side attractions of the molecules bind them together, so that the film has a certain surface energy of tension If the film is made to grow larger in extent, other molecules of the sodium oleate slip into their places and increase the area If the film contracts, molecules drop out and go back into the liquid

Let us suppose now that such layers are formed in the substance ethyl azoxybenzoate, which shows the smectic phenomena very well Each sheet is very flexible If such a sheet could be suspended in space, free from gravity, it would take the form of a perfectly flat surface because the molecules would tend to lie parallel to one another Their side to side attractions are relatively strong If bent, it would straighten itself out again If a number of such sheets were put together like the leaves of a book, they would tend to adjust themselves further, so that the ends of the molecules on the face of one sheet fitted exactly in some characteristic way on to the ends of the molecules on the next sheet In this way the solid crystal would be formed, in which there is arrangement and regular repetition in every direction in space But in the smectic state the temperature is high enough to ease the bonds between sheet and sheet, and yet not high enough to break up the sheets themselves A single sheet does not necessarily behave like a separate crystal it is rather to be considered as a two-dimensional fluid



$$C_2H_5-O-CO-C_6H_4\ \underset{O}{\underbrace{N-N}}-C_6H_4-CO\ \ O-C_2H_5$$

Ethyl *para*-azoxybenzoate
Solid – 114° – smectic – 120° – liquid

A sheet of this nature can slide without hindrance on its neighbours When a film of the above-mentioned substance is stretched over a small hole in a plate, the condition of parallel layers is in fact arrived at It can also be reached when the substance rests on a plate, but unless the plate is carefully prepared it is apt to be interfered with by local attachments, as will be seen presently In the simple form the substance may be examined in polarised convergent light, and will show the usual rings With the aid of a quarter-wave plate it can be shown by well-known methods that the arrangement simulates a positive crystal The full structure of the crystal is not realised because the separate sheets are not properly adjusted to each other That, however, does not affect the examination in convergent light, which requires only that the axis of the beam shall be perpendicular to the layers The experiment shows that the substance behaves like a positive crystal, such as quartz In other words, the frequency of the light vibrations perpendicular to the layers (and parallel to the molecules) is less than the frequency when the vibrations are not perpendicular thereto This is to be expected, because it is always found that vibrations along an extended molecule are slower than those across it

The simple stratification lends itself also to study by X-rays, when it appears that the thickness of the layer agrees closely with what we know of the length of such molecules, based on exact X-ray measurements of other organic molecules Friedel' gives the value 19 9 A In the solid crystal the thickness of the layer is found to be 16 2 A The difference is due to the fact that in the layers of the solid the molecules are inclined and not upright as in the liquid crystal

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* The photographs are due to Mr W J Green

In general, however, the substance, when placed between glasses, as is usual when examination is to be made under the microscope, and when raised to the proper range of temperature, or cooled from the melt, does not assume the simple form The strata are crumpled Attachments between substance and glass are strong, and at various points these attachments compel the arrangement of the molecules in different directions The general arrangement has to accommodate itself to enforced conditions in various places Moreover, nuclear associations of molecules are formed at various points in the liquid when it is passing into the liquid crystals phase , and these must be fitted to one another as they grow and meet together There is something like the contortion of strata in a geological formation , but the smectic arrangement is simpler, because the layers, while preserving their thickness exactly, can slide easily over one another and so can adjust themselves to surface conditions

The optical peculiarities of the smectic state are caused by these contortions of the strata We have therefore to consider in the first place the forms which the strata assume, and in the second their effect upon the transmission of light

From direct observation it can be inferred, as will be seen presently, that the surfaces of the strata form series of the 'cyclides' examined long ago by Dupin and known by his name We must therefore consider their chief properties

The locus of the vertices of the circular cones (cones of revolution) passing through a given ellipse is a hyperbola which passes through the focus of the ellipse and lies in a plane perpendicular to that of the ellipse Conversely, the ellipse is the locus of the vertices of circular cones passing through the hyperbola The ellipse and the hyperbola are described as 'focal conics'

Surfaces can be drawn which are at right angles to all the straight lines which pass through both conics These are Dupin's cyclides They are peculiar in that any pair of surfaces is equally separated everywhere, the distance of separation being measured along the common normal Obviously this makes it possible for the surfaces to coincide with the surfaces of sheets of uniform thickness.

It is easy to form an idea of the arrangement by considering a simple case The ellipse may become a circle, in which case the hyperbola becomes the axis of the circle, that is to say, a straight line passing through the centre of the circle and perpendicular to its plane The cyclides become 'anchor rings' or 'tores', intersected at right angles by every straight line that meets both circle and axis The construction is shown in Figs 2 and 3

When this simple case occurs in the liquid crystal, the strata are bounded by a succession of anchor rings equally separated The straight lines that meet both circle and axis are perpendicular to the strata and therefore parallel to the long dimension of the molecule As has been said above, the substance behaves like a uniaxial crystal, the axis lying along the molecule The straight lines show therefore the direction of the optic axis at every point, being parallel to the molecules round about the point It must not be supposed, however, that each such straight line is a chain of molecules , if that were the case converging lines of molecules would 'jam' into one another

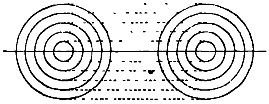

FIG 2—Section of an anchor ring in layers, which constitute a particular series of Dupin's cyclides

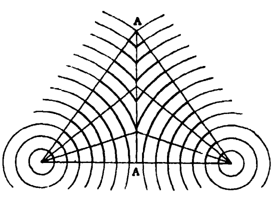

FIG 3—An axis *AA* is now added to the ring of Fig 2 Every straight line drawn from any point on *AA* to any point on the axial circle of the ring meets every layer at right angles In this figure emphasis is laid on those parts of the layers which lie within the cone of which the upper point *A* is the vertex and the axial circle is the circumference of the flat base Within the cone the layers are in equilibrium with each other How one cone can be fitted to another is explained in the text

It will be observed that no two of the straight lines intersect We may pass from this special case to the general by imagining the circle to become an ellipse and the cones to be pushed over to the side as in Figs 4 and 5 The anchor rings become distorted, but the characteristic properties of the cyclides are still maintained Every straight line that meets both ellipse and hyperbola is normal at all points to a series of surfaces, and still any two of the surfaces are everywhere separated by the same distance, measured along the common normal

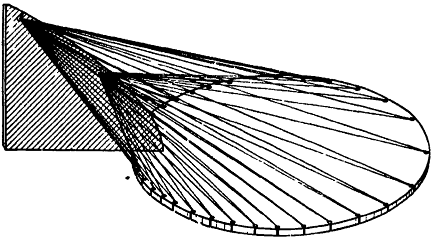

Fig 4 —A drawing of a model made to illustrate the structure of the interior of an oblique cone containing the smectic substance The two sheets of zinc are cut into the form of an ellipse and part of a hyperbola, and are fastened together so that their planes are perpendicular to each other and each curve goes through the focus of the other Slots are cut as shown, and strings join two points on the hyperbola to a number of points on the ellipse If the ellipse were made into a circle, the hyperbola would become the axis of the circle as in Fig 3 The strata, having the form of Dupin's cyclides, intersect every one of the strings at right angles

If now we take any two points on the hyperbola, of which one may be the focus of the ellipse, and draw from each of them straight lines to every point on the ellipse, we include a region bounded by two cones, or in the special case one cone and its flat base, which can be divided by Dupin cyclides into a series of sheets of uniform thickness, and at all points on the surface of the space the sheets are perpendicular to the generators of the cones

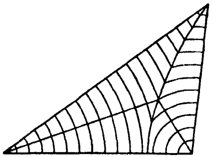

Fig. 5 —A section of Fig. 4 in the plane of the hyperbola, showing parts of cyclides. Compare this with Fig 3 The complete cyclide which in Fig 3 was a uniform ring, the so-called 'anchor ring', is now thicker on one side than on the other

We are now going to see how, in imagination, we can divide a solid mass of material, such as that which lies on the microscope slide, into separate blocks, in each of which the substance is arranged on one or more sets of cyclides, while all the blocks can be fitted together so that the stratification runs continuously through the whole.

If two such conical regions are made to touch along a common generator, the cyclides in one region may be looked on as continuations of the cyclides in the other, though they come into contact only at the common generator. Any pyramidal space can be divided into cones, large ones in the centre, smaller cones partially filling up corners that are left, and still smaller cones filling up corners that are still left, and so on The pyramidal space can then be further sub-divided into strata of uniform thickness by sets of cyclides, one set to each cone, which all fit on to one another, and meet at right angles the straight lines drawn from the vertex to all the points on the polygon forming the base In each of the cones the vertex and the focus of the ellipse forming its base are the two terminal points on the hyperbola belonging to that cone. Since all the hyperbolæ lie on planes that are perpendicular to the bases of the cones, which bases are co-planar, and all pass through the vertex of the pyramid, the major axes of the ellipses all pass through the projection of the vertex on the basal plane

A solid block can be divided into two sets of pyramids, half of which have their bases on each one of two opposite faces and vertices on the other, together with certain wedge-like spaces. This is readily seen if we consider such a division as is indicated in Fig. 6, where the pyramids are, for simplicity, set on square bases; and it appears that besides the pyramids there are wedges or tetrahedra such as *IJPQ*. Pyramids and wedges account for the whole. Now the top and bottom edges of each wedge can be looked on as portions of a pair of focal conics, and the space inside the wedge can be divided by cyclides which meet the other four edges at right angles and therefore pass continuously into cyclides in the adjoining pyramids The top and bottom edges must have at least some small curvature If straight lines be drawn from every point on the upper edge to every point on the lower, they are all normal to the set of cyclides which divide the space inside the wedge into layers of uniform thickness Thus the whole of a solid block can be divided into uniformly thick contorted layers by Dupin cyclides belonging to a number of different sets which, however, fit on to each other perfectly

We have next to show that the optical effects are consistent with such an arrangement, and in fact establish its existence

In a solid crystal the direction of the axes is constant throughout In a liquid crystal this is not the case Fortunately for our convenience in solving the new problem, there is only one axial direction at each point, namely, that which is perpendicular to the layer, it coincides with the straight line passing through the point and also through the two focal conics We may divide into two parts the problem of the path of a ray through a liquid crystal Consider first the case when a continuous change in the direction of the crystal axis is taking place in the plane containing the path of the ray Let that plane be the plane of the paper and let the axes be directed towards the point *O* in Fig 7 Clearly a vibration which is perpendicular to the plane is always perpendicular to the axis wherever it is, and is never deflected But a vibration in the plane of the diagram is that of an 'extraordinary' ray and suffers continuous deflection Its path was calculated by Grandjean[8] who showed that it moves on the curve $r \cos n\alpha = a$, where r and α are polar coordinates, *O* being the pole, n is the ratio of the refractive index of the extraordinary to that of the ordinary ray, and a ($= OA$) is a constant If $n = 1$, the curve becomes a straight line, as it ought to do, since the substance would then behave as if isotropic, and a ray of light would go straight through. The curve in the figure has the two straight lines *OP* and *OQ* as asymptotes, and the angle $POQ = \pi/n$ An extraordinary ray approaching along a line originally parallel to *OP* but not directed at *O* is finally deflected along *OQ* At the beginning and the end it is very nearly an ordinary ray To sum up, ordinary rays consisting of vibrations normal to the diagram suffer no deflection, but extraordinary rays do

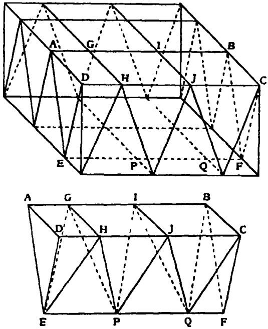

FIG 6 —The rectangular block is divided by saw-cuts into wedges the division being made in two ways, parallel to two of the edges of the block Below the block is shown one of the wedges obtained by cutting parallel to *AB* The second set of cuts, parallel to *AD*, divides this larger wedge into pyramids such as *P*(*GHIJ*) and smaller wedges such as *IJPQ*

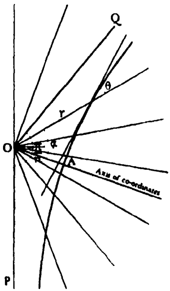

FIG 7 —The curved line shows the path of the extraordinary ray in a medium in which the axial direction at any point is directed towards *O* The axes and the path lie in one plane.

Next we consider a ray passing through a region where the direction of the axis is changing continuously but is always normal to the direction of the ray Such a structure may be termed a twisted or helicoidal structure In any plane which is normal to the ray, the direction of the axis is the same at every point but the direction changes continuously along the ray, as happens in a pack of cards to which a twist has been applied about an axis perpendicular to the plane of the cards

It is not to be expected that a polarised ray would maintain unchanged the rectilinear character of its vibration during its passage through such a medium , in fact, Maxwell's equations of the electro-magnetic field cannot be satisfied by so simple an assumption But if we try an elliptically polarised ray and suppose that the axes of the ellipse follow the twist, we find that the equations are satisfied for certain degrees of ellipticity and corresponding velocities We have therefore found the solution of our problem * A particular case is alone of importance to us here In cases with which we are dealing, the wave-length λ is very small compared to p, the pitch of the screw As Mauguin showed in the case of the nematic substances which we shall examine later, it is not possible to twist the medium so much as to make λ/p anything but a small fraction It appears that the ellipticities are then small, and the result can be expressed as follows :—

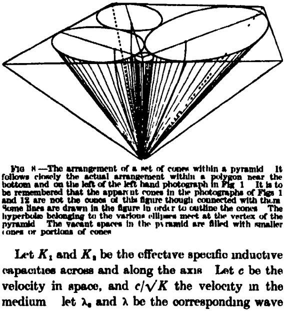

FIG 8 —The arrangement of a set of cones within a pyramid It follows closely the actual arrangement within a polygon near the bottom and on the left of the left hand photograph in Fig 1 It is to be remembered that the apparent cones in the photographs of Figs 1 and 12 are not the cones of this figure though connected with them Some lines are drawn in the figure in order to outline the cones The hyperbolæ belonging to the various ellipses meet at the vertex of the pyramid The vacant spaces in the pyramid are filled with smaller cones or portions of cones

Let K_1 and K_2 be the effective specific inductive capacities across and along the axis Let c be the velocity in space, and $c/\sqrt{K}$ the velocity in the medium let λ_0 and λ be the corresponding wave lengths Let a and b be the axes of the elliptical vibration Then *either* —

$K = K_1$ to the second order of small quantities and $b/a = 2\lambda K_1/p\ (K_1 - K_2) = 2\lambda_0\sqrt{K_1}/p\ (K_1 - K_2)$ *or* $K - K_2$ and $a/b = 2\lambda_0\sqrt{K_2}/p\ (K_2 - K_1)$

It appears therefore that in the twisted medium two elliptical vibrations can travel without change of form, each with its special velocity When the twist is small we may assume that incident light is resolved into two linear vibrations, the ellipticity being negligible These vibrations, however, follow the twist, so that the vibrations at any point are always along and perpendicular respectively to the crystal axis at that point If exactness were necessary, we should have to recognise that incident light is always resolved into two elliptic vibrations of different ellipticities travelling with different speeds For example, a polarised ray, in which the vibration is parallel to the crystal axis at the surface, is resolved into two elliptic vibrations which travel at different rates The major axis of the larger lies in the direction of the incident vibration, that of the smaller is perpendicular to it and is equal to the minor axis of the larger The two rotate in opposite directions At regularly spaced depths in the medium the two again combine into a linear vibration

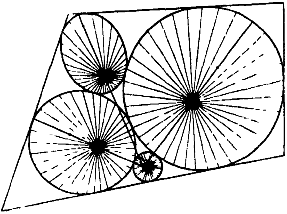

FIG 9 —This shows the base of the pyramid in Fig 8 and the axial directions radiating from every focus at the base of the hyperbolæ (see Fig 8) The axes of the ellipses all meet at a point which is the projection of the vertex of the pyramid upon the base

It is to be observed that this effect is practically independent of the wave-length The rate of rotation for all wave-lengths is that of the mechanical structure

Any axial direction can be brought into coincidence with any other axial direction by a rotation in the plane containing the direction of the ray combined with a rotation about the ray Thus we are able to say, as the result of the two cases considered, that the ordinary ray goes through the liquid crystal without any change in the direction of its path, no matter how the axis of the crystal alters its direction, provided that the latter alteration is continuous The direction of the vibration changes in such a way that it is always perpendicular to the axis of the crystal On the other hand, the extraordinary ray, though behaving like the ordinary ray in all other respects, continuously changes the direction of its path when there is any continuous change in the orientation of the crystal axis, which has a component in the plane containing the ray and the axis

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* A short proof is given in *Proc Roy Inst*, [illegible], 90 , 1934

We can now proceed to examine the appearance of a smectic substance in the light of what we have just proved Let us consider the photographs in Fig 1 These are typical of the great variety of appearances presented by a thin layer of ethyl azoxybenzoate It is in the smectic state, the temperature being held between the limits 114°C and 120°C The microscope is focused on the upper surface of the layer and is viewed through an analysing Nicol There is no polariser We observe at once the assemblage of polygons each with its content of ellipses If we suppose that the substance is crumpled up into a combination of sets of cyclides as explained above, and also that these are grouped in cones, pyramids and wedges (see Figs 4, 5, 6, 8 and 9) then the arrangement of the optic axes in the surface of the layer will be as in Fig 9, with infinite possibility of variation in the number and sizes of the ellipses The molecules on the surface lie always on straight lines, which show the directions of the crystal axes at every point, and in each ellipse radiate from the focus to the circumference

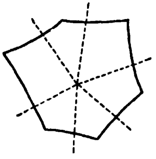


Fig 10—This shows the disposition of polygon edges in one face of the lower left hand portion of Fig 12 with respect to polygon edges in the other face

At every point the vibration in the ordinary ray as it emerges is perpendicular to the radius vector from the focus The original beam divides into two on entering the substance, as usual, but the extraordinary ray quickly goes astray If it gets through, its vibration is inclined to the radius vector, but its appearance is quite irregular On the other hand, the ordinary ray appears uniformly at all parts of the field and gives the clear picture which is seen in the microscope The analyser transmits vibrations parallel to its principal plane, and consequently each ellipse is crossed by a shadow which culminates at the focus The central line of the shadow is parallel to the principal plane of the Nicol It will be observed that when a polygon includes several ellipses, the major axes of those ellipses are all directed towards a single

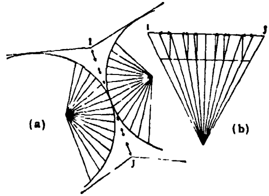


Fig 11 - This shows how the crystal axes in the edge of the wedge *IJ* are at right angles to the axes inside the ellipses where they touch the edge (*a*) About the middle of the edge the axes are often vertical This is very often the case in the left hand illustration in Fig 1 The light from below gets through on this line without being resolved, and is only half darkened by the analyser The section of *IJ* marked off by arrow heads represents the direction and relative values of the axial projection on *IJ* the manner of doing this is shown in (*b*)

point, which, as already explained, is the projection upon the polygon of the vertex of the pyramid standing on the polygon The vertex lies on the opposite face When the microscope is adjusted so that the lower face is in focus, it is found that the point on which the major axes of the ellipses converge melts into a point where a number of edges of polygons meet This is illustrated in Figs 10 and 12

The polygon edges of Fig 1 vary in shade, some being light and some dark It will be observed that the dark edges are more or less parallel to the middle line of the shadow in each polygon , and therefore also to the crystal axis along the edge This is readily understood when we remember that the side of the polygon is the top edge of a wedge Inside a wedge the axes run from every point on the top edge to every point on the bottom edge Along the top edge the projection of the axes is therefore parallel to the edge as shown in Fig 11 Somewhere in the edge, however, there is a point, unless the wedge is very skewed, where the axis is perpendicular to it, being the shortest distance between the top and bottom edges At this point the extraordinary becomes equivalent to the ordinary ray. There is no separation when the light enters the medium, and the analyser does not quench it entirely A black edge then shows a white spot in the middle

From the general and close agreement between theory and observation, we may surely conclude that the smectic substance is indeed arranged in strata which take the form of Dupin's cyclides There are, however, any number of other geometrical arrangements of sheets of uniform thickness There must be a reason why the cyclides are preferred, and it must be based on energy considerations A soap film stretched on a frame takes a form involving minimum energy, if the pressure is the same on both sides the total curvature is everywhere zero, and the edges comply with enforced boundary conditions In the same way the strata in the smectic state must also, while obeying boundary conditions, arrange themselves so that the potential energy is a minimum

Simplicity and symmetry imply less storage of energy than unnecessary complication and lack of symmetry Let us consider possible methods of arrangement in declining order of symmetry

If strata, originally plane and parallel to each other, are forced out of this arrangement, which is the simplest of all, they must tend to take the cylindrical form which comes next in simplicity. If the disturbing influences are complicated, the various attempts to adopt the cylindrical form must in some way be accommodated to each other A set of strata of even thickness, bent into cylindrical form, is so grouped round the axis of the cylinder that the normals to the strata at all points intersect the axis at right angles It is not possible, however, to divide a mass of the smectic substance into cylindrical groupings of this kind, the various groupings cannot be made conformable with each other

In the next order of simplicity the normals to the strata still meet in a line, but are inclined to it, forming cones of revolution, the vertices of which are points on the line, the inclination being constant in all directions radiating from any point on the line This is illustrated in various preceding figures, for example Fig 4 Each cone is symmetrical about its axis

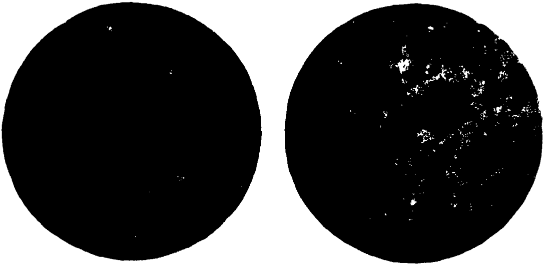


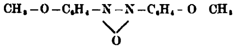
FIG 12 —Two photographs of the same portion of a smectic preparation, but in that on the right the upper surface is in focus, and in that on the left the lower In the lower left hand portion of the photograph on the right is a fairly regular six-sided polygon, of which the centre is occupied by an ellipse which is nearly a circle A number of smaller ellipses lie within the same polygon The axes of all those ellipses are directed to a point When the other surface is brought into focus this point is seen to be the meeting place of six polygon edges, as is shown by the illustration on the left This point is the vertex of a pyramid standing on the six sided polygon The six lines that meet in a point on one face are the upper edges of wedges of which the lower edges are the sides of the polygon on the other face They are separately at right angles to these lines because focal conics, however viewed, always seem to intersect at right angles See Fig 10

It is this arrangement which is adopted. Every normal to the strata is anchored on two lines which are focal conics Every boundary surface of the strata is as symmetrical as possible, being at right angles to series of cones of revolution, and the various sets of surfaces are conformable to each other as we have seen. The cyclides are the only surfaces which fulfil these conditions The geometry of the cyclide was considered by Clerk Maxwell[6], who pointed out that if the rays in a beam of light pass through two focal lines, the lines are necessarily parts of focal conics. The wave surfaces are equally spaced cyclides to which all the rays are normal

A useful list of substances which may exist in the smectic state is given by Friedel in the paper already referred to[2] The azoxybenzoate is often taken as typical, as it is easily made to show all the smectic characteristics

NEMATIC CRYSTALS

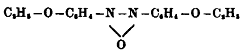
The second of the three classes of liquid crystals outlined by Friedel, was called by him 'nematic', from the singular appearance of mobile threads, either free in the interior of the substance or attached more or less to the bounding plates These have none of the focal conic structures of the smectic substances, having in fact no stratification They possess optical properties, however, and therefore some degree of molecular arrangement What that arrangement is may well be inferred from a recent determination of the solid crystal structure by Bernal and Crowfoot[7] *Para*-azoxyanisole and *para*-azoxyphenetole are typical nematic substances



$$\mathrm{CH_3-O-C_6H_4-\underset{O}{N-N}-C_6H_4-O\ CH_3}$$

Para-azoxyanisole

Solid – 116° – nematic – 133° – liquid



$$\mathrm{C_2H_5-O-C_6H_4-\underset{O}{N-N}-C_6H_4-O-C_2H_5}$$

Para-azoxyphenetole

Solid – 135° – nematic – 165° – liquid

X-ray analysis shows that the molecules in the solid lie parallel to one another, but cannot be clearly separated into layers They interleave one another, or, to use the description by the authors referred to, they are imbricated. Certain indications found on the X-ray photographs show also that the degree of interpenetration is not sharply defined but is variable about an average value. Since the change from solid to the 'liquid crystal' form is so easy, there cannot be much variation in arrangement or bindings, and the natural inference is that, even more in the latter than in the former phase, the interpenetration lengthways is variable and easily effected We should therefore conceive of the substance as owing its mobility to the facility with which the molecules can be drawn past each other, while retaining a strong tendency to acquire or retain a parallelism between the long dimensions of the molecules and the direction of drawing

Another striking characteristic of the nematic state is the tendency for the molecules to be attached sideways to the slide or the coverslip If once a solid crystal has formed between the two glass surfaces, it is difficult to remove all traces of its having done so The substance may be completely melted and allowed to return to the nematic state, whereupon it will recrystallise more or less according to the same plan as before The melting does not remove all the molecules adhering sideways to the glass, and enough remain to redirect the molecules in their former orientation in each separate part of the preparation In the microscope, when the Nicols are crossed, the appearance is that of a map in which the different countries are 'differently tinted, because the general direction of the molecules in each part is peculiar to that part In each part the direction may be the same right through the preparation from one glass surface to the other, especially if the layer is thin. If one or both of the Nicols are rotated, the alternations of light and dark are the same as if the preparation were a section of a uniaxial real crystal Yet the substance is liquid (Friedel, *loc cit*) If particles of dust or other intrusions wander through it they move freely, while the optical effects are unchanged The orientations of the molecules are governed by those on the surface, and even if there is a stream flowing, they do not diverge from the common orientation of the section in which they are But, if they move into another section, they change the old orientation for a new one

Suppose now that the cover slip is moved, either by translation or by rotation with respect to the slide In many places it must consequently happen that the orientation of the molecules on the top face is different from the corresponding orientation on the face below The angle between them is α, let us say It then appears that there is a gradual transition from one orientation to the other on the way through ; the substance assumes a helicoidal or twisted arrangement If a polariser is set parallel to the molecules on the lower surface, the analyser, in order to obtain extinction, must be set, not in the perpendicular direction but at an angle α thereto We have a straightforward example of the twisted medium which we have already considered Both ordinary and extraordinary rays follow the screw-like arrangement of the structure, the vibration in the one remaining always normal to the molecule, and therefore to the optic axis, while the other vibration is always parallel to it In this case there is no deflection of the extraordinary ray

The substance in the nematic state does not always assume the simple arrangement in plane sheets, in which the axes are parallel to the surface If it is cooled quickly from the amorphous phase, or if less care is taken in the preparation of the glass plates, it becomes full of complicated vortices and intertwinings Among these are the fine lines or threads from which the phase derives its name, they are especially obvious where the preparation is thick The threads are lines of discontinuity close to it There must then be a deflection of the ordinary ray because the thread is visible It may be that there is actually a hollow cylinder—perhaps vacuous—providing a reflecting surface, or it may be that the excessive strain of the medium close to the thread actually alters the refractive index of the ordinary ray

The latter explanation would involve the introduction of a principle not used hitherto in these considerations It has been sufficient, so far, to ascribe the optical effects to geometrical arrangement The extraordinary ray, on the other hand, may be deflected, since it passes through a region in which the crystal axis is continuously changing its direction in the plane containing axis and ray giving rise to optical effects, in accordance with the calculations made above A thread might be a line which is the meeting place of crystal axes at all points of its length, as in the smectic case There is now no necessity, however, for the line to be part of an ellipse or hyperbola, because it has no companion with which to form a pair of focal conics Or again, it might be a line round which the medium is circulating, corresponding to a vortex ring, which is either complete or anchored at two ends The molecules and the optic axes are then tangential to circles having the line as axis Sometimes a line marks the boundary between two portions in which the axial directions are different

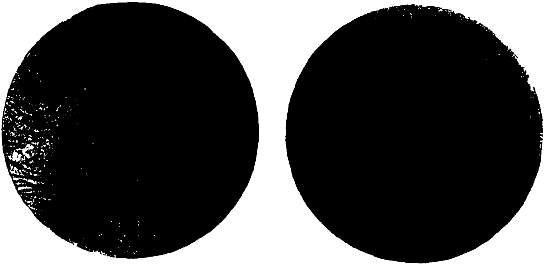


FIG 13 —The two photographs show the same substance, para-azoxyphenetole in the nematic phase, at two moments separated by as short an interval as possible The only difference is that the position of the analyser in one case is approximately at right angles to its position in the other No polariser The clearer portion of each photograph is seen by ordinary rays, and the other by extraordinary rays

In these cases, the ordinary ray is not deflected as it passes by the thread, unless it passes very

From this point of view we see at once the explanation of a very remarkable and characteristic appearance of the nematic substances, which is illustrated in the photographs of Fig 13 These are photographs of the same preparation, taken one after the other as quickly as possible so as to avoid changes due to the continuous movement of the liquid The light entering from below is not polarised but passes through an analyser after crossing the preparation The obvious difference between the two photographs is due to the fact that the analyser was rotated through about 90° between the two exposures The threads that look narrow and clear in one photograph are distorted in the other, a close comparison will show that otherwise the two photographs are identical

The remarkable feature which demands explanation is the fact that all the threads in one part of the picture should be clear simultaneously, while in another part they are all blurred We remember, however, that there can be a skin or pellicle, to use Friedel's term, in contact with the glass surface, in other words, the previous existence of a solid crystal there has left molecules on the glass which all point the same way, like a flock of birds on the ground which all head up into the wind This sets the orientation of other molecules in the near neighbourhood of the glass, and though the molecules may be orientated in all kinds of ways between the top and the bottom of the preparation, the change is never discontinuous except in the thread' itself, even then the continuity passes round the thread, if not through it Consequently the ordinary rays emerge with their vibrations perpendicular to the axis of the pellicle at the point of emergence, though when the rays passed by the thread, the vibrations were all parallel or perpendicular to the thread, according to the view which we take of the nature of the thread The vibrations of the extraordinary rays are all perpendicular to those of the ordinary The analysing Nicol can therefore be set so as to extinguish all the extraordinary rays and transmit only the ordinary, so that the threads are seen clearly If the Nicol is set so that the view is obtained by means of the extraordinary rays, the images are blurred because those rays are deflected out of their course by going near the threads

The whole effect depends on the compelling power of the pellicle, setting an arrangement at the surface to which the internal arrangement, whatever it may be at a distance from the surface, must gradually conform as the distance from the surface diminishes The vibrations have been orientated in a different direction at each point of the tortuous thread, but have all been pulled into one direction when they emerge In Fig 13 there are two regions, in one of them the molecular direction in the surface happens to be more or less at right angles to the direction in the other so that when one part, seen by ordinary rays, is clear, the other, seen by extraordinary rays, is confused The optical effects of nematic threads have been studied by H Zocher and his colleagues[8]

When the *para*-azoxyanisole is cooling down from the liquid, the first appearance of a change of phase is the formation of separate groups of molecules, which between crossed Nicols give the effect illustrated in Fig 14 Each group shows, besides finer details, a cross, the arms of which are parallel to the principal planes of the Nicols A similar effect may be observed in certain solids, such as strontium carbonate or salicin, and occasionally lavas and glasses, and in organic substances such as cholesteryl acetate It is an indication that in each group there is a nuclear point from which the axes of minute crystals radiate uniformly in all directions In two of those directions, mutually at right angles, the axes of the crystals are parallel respectively to the principal planes of the crossed Nicols If the preparation is rotated with respect to the Nicols, the cross does not move The group is therefore independent of any pellicles, it is floating freely in the middle of isotropic liquid The molecules either radiate from the nucleus in the centre, or are arranged along concentric circles as if there were a vortex Either arrangement gives the cross On one side of Fig 14, the groups are coalescing and are attaching themselves to the glass above and below The connexions are irregular but there are traces of the original simple arrangements of the groups On the border between the liquid crystal phase are larger groups formed by the coalescence of smaller groups

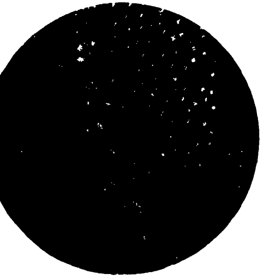


FIG 14 —*Para* azoxyanisole cooling between crossed Nicols On the left the nematic state is advancing Small drops are forming in the liquid on the right The arms of the crosses are parallel to the principal planes of the Nicols The larger drops are formed by coalescence of the smaller

CHOLESTERIC CRYSTALS

The third class of liquid crystals has been termed by Friedel the cholesteric In some ways its properties resemble those of the smectic and nematic classes But we meet here with a new effect, a brilliant coloration of which the causes and laws have never been fully explained

We may take as an example

$$C_6H_5-CH=CH-CO-O-C_{27}H_{45}$$

Cholesteryl cinnamate

Solid – 156° -- cholesteric – 197° – liquid

When this substance is allowed to cool down from the liquid phase, it presents at first a confused appearance of a focal conic structure But a slight mechanical disturbance causes it to assume a form in which it reflects brilliant colours like those of a peacock's feather The colour depends on the temperature, being vivid green at the higher temperatures and golden-bronze at the lower But the most remarkable effect is that the reflected or, more correctly speaking, scattered light, is circularly polarised If the incident light is circularly polarised, it is reflected if the circulation is represented by a right-handed screw, and transmitted if the screw is left-handed In the case of some other cholesteric substances this is reversed More remarkable still is the fact that the scattered light is right-handed, like the absorbed light to which it is due In all other known cases of the reflection of circularly polarised light the sense of the rotation is reversed.

These substances, when in their characteristic state, are optically active to an extraordinary degree, represented sometimes by as much as a whole turn in the hundredth of a millimetre.

This short account of the chief properties of 'liquid crystals' is very far from complete Nothing has been said of the influence of electrical and magnetic fields on molecular arrangement, which is strong in the case of substances in the nematic phase but absent in the smectic, except during the process of cooling from the liquid Nor has reference been made to the peculiar facility with which the molecules of liquid crystals dispose themselves in particular directions on fresh cleavage faces of solid crystals Nor have the viscosity effects been described In spite of these omissions, the account may help as an introduction to the extensive literature of the subject, the more so because the accumulated observations are scattered over many scientific journals, and because also the various workers are far from agreement as to their interpretations

[1] O Lehmann, 'Über fliessende Kristalle', *Z phys Chem*, 4, 1889

[2] *Ann Phys*, 9, 18, 273, 1922

[3] *Trans Faraday Soc*, 29, 881 1933

[4] *Comptes rendus*, 180, 265, 1925

[5] *Bull Soc Min*, 42, 42, 1919 See also *Proc Roy Inst*, 28, 89, 1934

[6] Collected Researches, 8, 144

[7] *Trans Faraday Soc*, 29, 1032, 1933

[8] Zocher and Birstein, *Z phys Chemie* A, 142, 113

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Progress in Wool Research

A PAMPHLET recently issued by the Wool Industries Research Association summarises, under the title "Scientific Research applied to the Wool Industries", a number of the practical results of the work These include the invention of durable sheep-marking fluids *completely removable in subsequent processing* and leaving no traces in the finished fabric The investigations on the recovery of wool grease from scouring liquors have contributed largely to the development of three processes in use at Bradford and elsewhere, while those on wool scouring, for example, have made possible the actual detection and commercial control of variable alkalinity by means of indicator cloth. The discovery of the chemical changes responsible for discoloration in carbonising have enabled adequate precautions for prevention to be taken Improved 'ionised' oils have been developed for the lubrication of wool Fundamental issues underlying the woollen spinning process have been elucidated, a new principle in roller drafting has been discovered for use in the spinning of dry combed rovings and a general relation developed between count, twist and strength for single worsted yarns. Causes of deterioration of spinning ability of dyed wool have been ascertained and of damage in fabrics through lead staining in weaving. Mothproofing and preservation against moulds and mildew have been important fields of work, and in these and in many other ways the application of quantitative measures has assisted in the control and efficiency of the numerous processes with which the wool industry is concerned

Association of Scientific Workers

THE annual report of the Executive Committee of the Association of Scientific Workers presented to the Council on February 24 refers to the formation of a National Parliamentary Science Committee as an outcome of negotiations with the British Science Guild as the outstanding special work of the year. The support of twelve leading institutions has been obtained, and the committee includes Sir James Henderson, Prof. Miles Walker, Prof Blackman, with Commander Bernacchi as chairman, and Mr. A. Howard and Mr. H J. W. Stone as joint honorary secretaries In consequence, the Parliamentary Committee of the British Science Guild and of the Association have been disbanded. The compilation of a "Handbook of Extra-University Research in Pure and Applied Science", giving data concerning commercial, endowed and private research laboratories, has been completed and negotiations for publication are in progress. It is believed that the handbook will serve as an advertisement of British research activities and of the interest taken by British industrialists in maintaining the highest efficiency in factories. The book may become a standard work of reference alongside the "Universities Yearbook" and the "Year-Book of Scientific and Learned Societies".

THE Association has been active in combating the evil of bogus degrees and has been in negotiation with the universities to secure their support of successive Bills introduced in the House of Lords by Lord Jessel to deal with this evil. The Association collected a considerable amount of information regarding the granting of degrees by five different British 'degree-mongers' but has so far been unable to induce the universities to withdraw their opposition at the third reading of the Bills The finance of the research associations has received attention and is being considered by a joint Committee of the Association and the British Science Guild. The production of "Science in Parliament" has continued and a memorandum has also been prepared on the relation of the unification of national transport, the construction of ship-canals across Britain, the reconstruction of derelict canals and land-drainage The report concludes by directing attention to the resolution passed that members should seek to assist towards a better adjustment between scientific advances and social progress

Absence of Winter Rains in England and Wales

THE Director of the Meteorological Office, Air Ministry, states that the rainfall over England and Wales has been less than the average for nine out of the last eleven months. August, November, December and February stand out conspicuously for their dryness In October and January the fall was slightly above the average but there is not a single month of large excess. Taking the period as a whole, the rainfall was everywhere less than the average except along a strip of the east coast from Newcastle to Hull and again near Yarmouth There were two areas in which the deficiency was particularly large, the fall amounting only to about two thirds of the average The first of these is bounded roughly by the counties Breconshire, Bedfordshire, Somersetshire and Surrey , the second includes the Cheshire plain and the coastal strip of Lancashire. The absence of the winter rains on which we rely to such a large extent for keeping up our water supplies is remarkable The rainfall for the four months November–February was less than half the average over a great part of the country south of a line from Aberystwyth to Yarmouth, and there are regions of similar deficiency to the west of the Pennines and in south Lancashire In January, heavy falls amounting to about 20 inches fell in Snowdonia and the English Lake District, but less than two inches were measured over the eastern half of England, and less than an inch in the neighbourhood of Middlesbrough and the Wash The deficiency for February was also marked. Totals of more than an inch were confined to Snowdonia, the neighbourhood of Borrowdale and parts of the north-east coast Locally, for example at Patching Farm near Littlehampton, there was *no measurable rainfall for the whole of the month*, a very unusual occurrence The partial failure of the winter rain has been the most severe since the memorable winter of 1879–80, which, however, followed a wet summer, whereas the summer of 1933 was dry

Award to Dr. F. W. Pennell

THE first award of the George W Carpenter fund for encouragement of scientific research was made on

February 20 by the Academy of Natural Sciences of Philadelphia to Dr Francis W. Pennell, curator of botany in the Academy, for his work and study on the snapdragon family (Scrophulariaceæ) of eastern North America. In presenting the 250 dollars honorarium at the annual meeting, the president announced that this fund also will permit publication of Dr Pennell's book on the subject The George W Carpenter fund is a bequest from the late Mrs Ellen D C Bennett, in memory of her father, one of the Academy's earliest members, who served as treasurer from 1826 until his death in 1860 Dr Pennell was appointed curator of botany at the Academy in 1921, and under his direction this Department has become one of the largest of its kind in the United States, containing at the present time more than 600,000 specimens of plants and flowers from all parts of the world Among these are some of the oldest and most valuable of American collections

Ray Society

At the annual general meeting of the Ray Society held on March 13, the following officers were re-elected: *President*, Sir Sidney Harmer, *Treasurer*, Sir David Prain, *Secretary*, Dr W T Calman Mr J M Offord was elected a vice-president in succession to the late Canon G R Bullock Webster, and Mr R. S W Sears, Mr M A C Hinton and Mr A G Lowndes were elected new members of Council The Council's report directed attention to the decline in the receipts from all the regular sources of the Society's income, and stated that unless further support for the Society is obtained, a regrettable curtailment of publications may soon become necessary It was stated that the plates for the second volume of Prof T A. Stephenson's "British Sea Anemones" are being engraved, and it is hoped that the volume will soon be in the press The Council reported with gratitude the receipt of a donation of £30 towards the cost of this volume from Miss Teresa Gosse, the grand-daughter of Philip Henry Gosse, author of the "Actinologia Britannica" (1860)

Soviet Stamps in Commemoration of Mendeléeff

THE Soviet postal authorities have issued a series of new postage stamps to commemorate the centenary this year of the birth of Mendeléeff The new issues are of five, ten, fifteen and twenty kopek denominations The five and the twenty kopek denominations bear a design of the Mendeléeff monument against a background of his table of the periodic system of elements, the ten and fifteen kopek denominations bear a portrait of Mendeléeff, also against a background of the table of the periodic system of elements All the stamps bear the commemoration date 1834–1934

Vital Statistics for the Year 1933

THE Registrar-General has issued a provisional statement of the figures for birth-rate, death-rate and infant mortality in Great Britain during the year 1933 For England and Wales, the live births and the deaths were respectively 14 4 and 12 3 per 1,000 resident population, and the deaths of infants less than 1 year old, 64 per 1,000 registered live births For the fifth year in succession the birth rate was the lowest on record, being 0 9 per thousand below that of 1932, and 1 4 below that of 1931 The death rate was 0 3 above that for 1932 and is the same as that for 1931 The infant mortality rate was 1 per 1,000 below that for 1932, and with the exception of the year 1930 (60) is the lowest on record

Announcements

AT the annual general meeting of the Physical Society, held on March 16, the following officers were elected *President*, The Right Hon Lord Rayleigh; *Vice-President*, Dr D Owen, *Secretaries*, Dr Allan Ferguson (*Papers*), Dr Ezer Griffiths (*Business*); *Foreign Secretary*, Prof O W Richardson, *Treasurer*, Mr R S Whipple, *Librarian*, Dr J H Brinkworth, *New Members of Council*, Mr H H Emsley, Prof H R Robinson

THE Institute of Physics has put forward a scheme for the training and certificating of laboratory and technical assistants in physics, and proposes in due course to set up an appointments register Candidates for the Institute's certificates must attend approved courses of instruction and pass examinations in accordance with the regulations issued It is understood that evening class courses for the Institute's certificates will be commenced in September next in London

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —Engineers at the Fuel Research Station, East Greenwich—Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, S W 1 (March 26) An assistant in the Admiralty Technical Pool for duty at the Admiralty Compass Department —Secretary of the Admiralty (C E Branch), London, S W.1 (March 28). A veterinary officer under the Devon County Council—County Medical Officer, 4 Barnfield Crescent, Exeter (March 29) Two junior assistant engineers on the Manchester Corporation—City Engineer (March 30) Engineer and manager of the Weymouth Waterworks Company—Chairman (April 3). Water engineer and manager and gas examiner to the County Borough of Swansea—Town Clerk, Guildhall, Swansea (April 7) Principal of the County Technical College and School of Art, Newark —Clerk to the Governors (April 10) A demonstrator in zoology at University College, Nottingham—Registrar (April 11). A demonstrator in the Department of Inorganic and Physical Chemistry at Bedford College for Women, Regent's Park, N W 1—The Secretary (April 21) Two technical assistants (A. 587/8) and a draughtsman (A 589) at the Royal Aircraft Establishment, Farnborough, Hants—Chief Superintendent, quoting reference number above. Two resident staff tutors for adult education, University of Birmingham—Director of Extra-Mural Studies (April 23) University professor of anatomy at St. Thomas's Hospital Medical School, London—Academic Registrar, University of London, S.W.7 (May 16)

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Supraconductivity of Films of Tin

EXPERIMENTS on the relation of high frequency currents to the phenomenon of superconductivity led to work at Toronto with films of superconducting metals. The films (of tin) were produced by 'tinning' the surface of fine wires which themselves were not superconducting. In the early experiments a coating of tin 2 × 10⁻⁴ cm in thickness was 'wiped' on constantan wire of 0·016 cm diameter. In this way one obtains the equivalent of a thin cylinder of superconducting metal, and the resistance of the whole becomes zero below the transition temperature of the superconducting element used[1].

With the intention of studying further the effect of high frequency currents, samples of such coated wires were plated with other metals—for example, copper and nickel—which are not superconductors; an example of such a combination is constantan covered with tin and then plated with copper. The diameters of the wires forming the core were as follows: for constantan 0·056 cm, for copper 0·040 cm and for nickel 0·045 cm.

Preliminary experiments were carried out on these samples to confirm their reaction with respect to direct currents—the ordinary superconductivity test—and it was found that thin films of tin cease to show superconductivity when these films are themselves plated over with a film of a non-superconducting metal, for example, copper or nickel. This surprising result shows itself only with thin films, but a number of repetitions of the experiments renders the results unmistakable. The accompanying table shows the nature of the phenomenon; so far, only the superconductor tin has been tested in this way.

No	Sample	Thickness of Tin Film (cm × 10^{-6})	Thickness of outer layer (cm × 10^{-6})	Superconductive Action, direct current of 200 ma
1a	Constantan-Tin	10	0	Transition point 3·69°K
1b	Constantan-Tin-Copper	10	100	Not superconducting at 2°K
2a	Copper-Tin	9	0	Transition point 3·58°K
2b	Copper-Tin-Copper	9	100	Not superconducting at 2°K
3a	Nickel-Tin	9	0	Transition point 3·42°K
3b	Nickel-Tin-Copper	9	100	Not superconducting at 2°K
4	Constantan-Tin	6·8	0	Transition point 3·49°K
5	Constantan-Tin	2	0	Transition point 2·48°K
6	Constantan-Tin-Copper	18	40	Not superconducting at 2°K
7	Constantan-Tin-Copper	4	20	Not superconducting at 2°K
8	Constantan-Tin-Nickel	15	30	Not superconducting at 2°K
9	Constantan-Tin (wiped)	90	0	Transition point 3·68°K
9a	Constantan-Tin-Copper	90	80	Transition point 3·44°K
10	Constantan-Tin (electro-plated)	200	0	Transition point 3·76°K
10a	Constantan-Tin-Copper	200	80	Transition point 3·73°K
11	Tin Wire	diameter	0·065	Transition point 3·77°K

It is seen that as the film of tin increases in thickness, a point is reached at which the superconducting property of the tin film is not lost by surface plating. This phenomenon will undoubtedly be of importance in framing a satisfactory theory of superconductivity—a consideration of utmost importance in dealing with metallic conduction. This work is being carried on by J. O. Wilhelm and A. D. Misener.

E. F. BURTON.

McLennan Laboratory,
University of Toronto,
Feb. 17.

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[1] E. F. Burton, "Superconductivity" (University of Toronto Press, and Oxford University Press), p. 70. J. C. McLennan, NATURE, 130, 879, Dec. 10, 1932.

Persistent Currents in Supraconductors

UNTIL recently it was generally assumed that it was possible to predict, by the ordinary electromagnetic equations, the persistent current produced in a supraconductor cooled below the transition point in a constant external magnetic field after the field was switched off. Thus H. A. Lorentz[1] calculated the current induced in a supraconducting sphere, that is, the effective magnetic dipole when an external magnetic field is established.

According to results recently published by Meissner and Ochsenfeld[2], the matter is not so simple as might at first sight appear. Instead of the lines of force being 'frozen in' as had been previously assumed would happen when a supraconductor was cooled below the transition point in a magnetic field, it appeared that the field increased in the neighbourhood of the supraconductor, which behaved as a body of zero permeability. If this were so, the flux of induction in the supraconductor should be zero and one might expect, in contradistinction to the old view, that no persistent current or effective induced dipole would be produced by switching off the external field.

The following experiments seem to show that although supraconductors do not conform to the older theory, neither do they behave as though they had zero permeability.

(1) A solid tin sphere of 1·5 cm. radius was cooled from 4·2° K. to 2·5° K. (the liquid helium was produced in a liquefaction apparatus utilising the expansion method of Simon) in a field of 70 gauss. When the field was switched off, the magnetic moment of the sphere was observed with a test coil. Its magnitude was about one sixth of that calculated according to the Lorentz equation.

The magnetic moment remained almost constant whilst the temperature of the sphere rose from 2·5° to 2·9°; with a further rise in temperature it decreased steadily, becoming zero at 3·7°, the normal transition point of tin. Plotting the magnetic moment against the temperature, one obtains a curve of similar shape to that found for the magnetic threshold values.

(2) The same sphere was cooled to 2·5° without any external magnetic field, a field of 230 gauss (higher than the threshold value at this temperature) was switched on and immediately switched off. The magnetic moment thus produced in the sphere at 2·5° was 8 per cent greater than that produced in the previous experiment using 70 gauss, but as the temperature rose it decreased and at 2·9° it reached the same value as the magnetic moment at this temperature in the previous experiment. From 2·9° to 4° the curve coincided with that found in experiment (1).

(3) Similar experiments to those described above

were carried out with a hollow tin sphere of the same radius, the spherical space in the middle being equal in volume to one half the volume of the sphere. The magnetic moments produced in the hollow sphere were two to three times greater than those obtained with the solid sphere

In all these experiments the magnetic field was produced by a cylindrical coil in the middle of which the sphere was placed, all iron being excluded. Although the field near the sphere was thus fairly homogeneous, we think it possible that the observed phenomena may be influenced by slight inhomogeneities of the external field. In a completely homogeneous field it would seem possible that the method of cooling might affect the results. In order to test this, we cooled the spheres from the poles and also from the equator This did not seem to make any difference, the magnetic moment observed being of the same order of magnitude in either case.

As a result of these experiments, it seems certain that the effective permeability of substances when they become supraconducting decreases, as observed by Meissner and Ochsenfeld On the other hand, it appears clear that under our experimental conditions the permeability does not vanish entirely, as might be expected in view of the almost infinite conductivity, or if it does vanish, it only does so in certain regions and not throughout the whole volume of the supraconductor.

In conclusion, we would like to express our thanks to Mr T C. Keeley for his advice and assistance in various phases of the work

K. MENDELSSOHN
J. D. BABBITT

Clarendon Laboratory,
Oxford.
Feb. 17.

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[1] Comm Leiden, Suppl, Nr. 50 *b*, 1924

[2] *Naturwiss*, 21, 787; 1933.

Some Thermal Properties of Condensed Helium

IN the following communication we give the results of some preliminary measurements with condensed helium:

1. The heat of fusion is 6·75 cal./gm.-atom at 4·0° and 5·1 cal. at 3·4°.
2. The density of solid helium in equilibrium with the liquid phase is 0·23 at 4·0° and 0·22 at 3·6°.
3. The density and compressibility of liquid helium have been measured at 2·4° and 4·5° They are in good agreement with the data recently published by Keesom[1] We would add only that the compressibility still falls appreciably with higher pressure
4. The compressibility of solid helium could be measured roughly, the result being about $1·5 \times 10^{-3}$ reciprocal atm at 3·7° and 115 atm.
5. The specific heat of solid helium was determined between 2·7° and 3·7° at a density of 0·23. C_v agrees well in this region with a Debye function for $\Theta = 32·5°$. This small value (the smallest hitherto observed), which we find in spite of the small atomic weight, is another consequence of the very weak interatomic forces. From $\Theta = 32·5°$ follows a zero point energy of 73 cal./gm.-atom, compared with a thermal energy of only 1 cal. at 4°. We may mention that this value agrees well with the deviation from Trouton's rule if we attribute this to the zero point energy[2].
6. Measurements of adiabatic expansion were carried out in connexion with a proposed procedure[3] for lowering temperatures by changing the volume of condensed helium. The coefficient $\gamma = -(\partial \ln T/\partial \ln v)_S$ was measured for the liquid phase as a function of temperature and pressure We may mention as an example, that starting at 4·6° and 130 atm., 2·4° is reached by expanding to the vapour pressure Expansion experiments with solid helium have not yet been carried out, nor accurate experiments on the more easily made adiabatic expansion starting from the solid at equilibrium pressure We have done only one preliminary experiment starting from partly solidified helium at 4°, and this showed an appreciable increase in the cooling effect as compared with the effect obtained with only liquid present (The data given above, however, enable us to calculate these cooling effects Starting with solidified helium at the equilibrium pressure at 4°, one should reach a temperature of 1·4° by expanding to the vapour pressure As according to the measurements of Keesom[4] on the thermal expansion an adiabatic expansion of the liquid below the λ-point should lead to a temperature rise, a lower temperature will be obtained by expanding only until the substance is just melted Keesom's entropy diagram of the liquid[5] shows that in this case a temperature 0·15° lower should be reached Definite predictions of the cooling effects when starting at lower temperatures cannot be given yet.)
7. The knowledge of the specific heat of the solid phase enables us to fix the zero point of entropy according to Nernst's Theorem. The absolute value of the entropy of the liquid can now be calculated using the values of the heat of fusion, the data of adiabatic expansion and the specific heats Connexion can be made through the known values of vapour pressures and heats of evaporation with the theoretical value of the entropy of the gas, putting the statistical weight equal to unity according to the spectroscopic observations We find good agreement, the resulting chemical constant being −0·62 compared with the theoretical value −0·68

The investigations were carried out in 1932 in Breslau Their continuation is being undertaken in the Clarendon Laboratory

R KAISCHEW.

Sofia.

F SIMON

Oxford
Feb 25

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[1] W H. and A P Keesom, *Physica*, 1 128, 1933

[2] K Bennewitz and F Simon, *Z Phys*, 16, 197, 1923

[3] F. Simon, *Z Phys*, 81, 824, 838, 1933, see also W Meissner, *Z Phys*, 81, 832, 1933, and W H and A P Keesom, *Physica*, 1, 161, 1934

[4] W H and A P Keesom, *Kon Akad. v Wetensch Amsterdam*, 36, Nr 5, 1933

[5] W H and A P Keesom, *Physica*, 1, 161, 1934

A Mercury-Sealed Water-Cooled Rotating X-Ray Target

INSPIRED by the magnificent X-ray tube with spinning target designed by Müller[1] and now in operation at the Davy Faraday Laboratory of the Royal Institution, we have considered the feasibility of completely sealing off the rotating anode by means of mercury after the manner of the classical Torricelli experiment.

At first sight such a proposition seems absurd for an X-ray tube containing a glowing filament, but we have overcome the difficulty very simply by covering the inner mercury meniscus with a layer of Apiezon high-vacuum oil Fig 1, which is self-explanatory, shows diagrammatically a tube which we have constructed and proved to work, not as yet, owing to lack of resources, with the large currents Muller has used, it is true, but still under sufficiently stringent conditions to demonstrate the essential soundness of the method Even with ordinary steel steam tubes, unpolished on their inner surfaces, the vacuum was found to hold exceedingly well. The annular space containing the mercury was about ¼ in wide, and the pump used was a two- or three-stage oil diffusion pump. Incidentally, these experiments show that mercury gauges can safely be used in combination with such oil diffusion pumps, if the precaution is taken of covering the mercury meniscus with a layer of high-vacuum oil

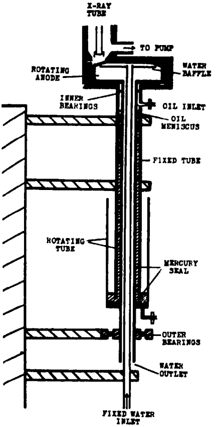

FIG 1.

The expenses of this investigation were met by grants from the Government Grant Committee of the Royal Society, and the Commissioners of the 1851 Exhibition. For the mechanical workmanship we are indebted to Mr. A. Robinson of this department.

W. T. ASTBURY.

R. D. PRESTON.

Textile Physics Laboratory,
University of Leeds.
Feb. 20.

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[1] A. Müller, NATURE, 124, 128, July 27, 1929.

Radio-Geological Survey of Czechoslovakia

BOHEMIA is an excellent region for radio-geological investigation In the first place, we have the ore region of Jáchymov (Joachimsthal), where pitchblende is found. However, in the Krkonoše (Riesen Gebirge) and in the Jizera Mts, where there are no deposits of pitch-blende, strong radioactive springs (containing up to 200 Mache units) occur very frequently along faults, contacts, etc This district has been investigated by us radio-geologically in the same manner as that in which Gensor investigated the German portion of the Krušné Hory (Erz Gebirge)[1]

During the last three years, we have gathered together much material by various experimental methods. Chiefly, so far as was possible, the radioactivity of springs in the whole area of the Krkonoše was measured systematically. The content of radium emanation was measured at different seasons of the year, the springs and their radioactivity were then marked on maps, so that radiological maps of the terrain might be formed, as suggested by Vernadsky, These maps will be made still more complete by the investigation of the soil-atmosphere In highly active springs the flow of the water, found to be inversely proportional to its radioactivity, was measured and its dependence on meteorological factors determined The springs are, therefore, regarded as superficial Further, the amount of radium was ascertained in the water of the strongest springs (of the order of 10^{-11} gm of radium element to 1 litre of water), and its quality by Elster Geitel's mesothorium method We have made also precise chemical analyses of the strongest springs

At the same time, analyses of the rocks in the neighbourhood of the springs have been made with regard to their contents in radium elements A simplification of Joly's method has been used, in which the rock is melted in the electric furnace, in cheap iron pans[2]. Likewise, rock sections were studied from the mineralogical point of view Correlation between geological structure and the analyses of waters and rocks were studied It was proved, for example, that at Žaly (Heidelberg on Benecko) waters became radioactive on contact with phyllite (radium content, $8 \cdot 3 \times 10^{-12}$ per gm) and orthogneisses (radium content, $4-7 \times 10^{-12}$ per gm) The total length of contacts is so great that the amount of emanation in the springs of this district (100 Mache units) can be easily explained by the absorption of emanation by the water along this quite superficial contact

A report of the first part of these investigations in the area of the Krkonoše will be published soon. We have dealt also with a large amount of material, especially from radiological investigations of the rocks from the ore region of Jáchymov and of rocks of organic origin from Bohemia and from Slovakia. This material will be completed and gradually published The aim of the work is a radio-geological survey of the whole of Czechoslovakia

W. SANTHOLZER.

Radiological Institute, Prague.

F ULRICH.

Charles University, Prague.
Feb. 27.

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[1] *Geol Rundschau*, 182, 1932

[2] Běhounek-Santholzer, *Gerlands Beiträge z Geophys*, 33, 60, 1931

Origin of the Angiosperms

THE cyto-genetic work of the past decade has built up an increasingly impressive body of data demonstrating the evolutionary importance of fertile, true-breeding hybrids originating through doubling of the chromosome number A considerable number of such hybrids (variously termed amphidiploids, summation hybrids, allopolyploids) have originated under observation Particularly interesting from the evolutionary point of view are Muntzing's 'synthetic' *Galeopsis Tetrahit*, produced from *G. pubescens* and *G speciosa*[1], and Karpechenko's *Raphano-Brassica*, an intergeneric hybrid which, were it found in Nature, would be considered a new genus[2]

An enormous body of indirect evidence suggests that similar 'summation hybrids' have occurred frequently in the development of many of the families of the angiosperms There is even some evidence for the reticulate origin of groups larger than the genus. For the sub-family Pomoideæ, the genetical and cytological evidence for the reticulate origin of that whole group from a cross or crosses between other members of the Rosaceæ is so strong that such a theory was put forward independently by Darlington and Moffett[3] and by Sax[4].

The following suggestion for a reticulate origin of the Magnoliales, though admittedly highly speculative, *is therefore not without precedent* Whitaker's recent work[5] has shown that these peculiar odds and ends do indeed form a natural order, though the affinity of certain of the genera (as, for example, *Cercidiphyllum* and *Trochodendron*) had previously been questioned He has suggested that the genera *Tetracentron*, *Drimys*, *Cercidiphyllum*, *Trochodendron*, *Magnolia* and *Liriodendron*, agreeing as they do in nodal anatomy and chromosome number, should be placed together in one group It is noteworthy that this group includes several genera which have been repeatedly considered as possibly transitional between the gymnosperms and the angiosperms, some of them being so placed by reason of their floral anatomy and others because of the structure of their wood Cytologically, the group is unusual by reason of its basic chromosome number of 19, which is seldom met with among the other families of the flowering plants

May it be possible that the Magnoliales originated from wide crosses between different groups of gymnosperms ? So far as chromosome numbers are concerned, the data are certainly suggestive. On the basis of chromosome number, the Gymnospermæ can be divided into two groups[6] To the larger group belong the Ginkgoales, Cycadales and Coniferales with base numbers of 12 and 11 To the smaller group belong the Gnetales, two genera of which have been found to possess base numbers of 7 *It will be seen that the chromosome number for the* Magnoliales is exactly what would obtain were a sterile cross between these two groups to double its chromosome number.

An *origin for the flowering plants* has usually been sought either among the Gnetales or the Cycadales. The evidence from chromosome numbers would suggest, *as one possibility*, that relatives of each might have contributed, reticulately, to the origin of the Magnoliales. For the immediate present, the cytologist can do no more than raise the question, "May the angiosperms have originated, in part at least, from crosses between some of the simpler members of the seven chromosomed and twelve chromosomed gymnosperms ?" The morphological evidence has not, I believe, been examined from this point of view. It would be interesting to know how far it supports such a hypothesis

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[1] Müntzing, A , "Cyto-genetic Investigations on Synthetic *Galeopsis Tetrahit*", *Hereditas*, 16, 105–154 , 1932

[2] Karpechenko, G D , "Polyploid Hybrids of *Raphanus sativus* L *Brassica oleracea* L ", *Z ind Abst u Vererb* , 48 , 1928

[3] Darlington, C D , and A A Moffett, "Primary and Secondary Chromosome Balance in Pyrus", *J Gen* , 22, 129–151 , 1930

[4] Sax, Karl, 'The Origin and Relationships of the Pomoideæ", *J Arnold Arb* , 12, 3–22 , 1931

[5] Whitaker, T W , '*Chromosome* Number and Relationship in the Magnoliales", *J Arnold Arb* , 14, 376–385 , 1933

[6] Sax, Karl and Hally J Sax, "Chromosome Number and Morphology in the Conifers", *J Arnold Arb* , 14, 356–375 , 1933

Tischler, G , Pflanzliche Chromosomen-Zahlen", *Tab Biol* , 6, 109–226 , 1931

Chemotropic Response of a Chironomid Fly (*Forcipomyia* sp.) to Petroleum Oils

SINCE the discovery of the attraction of the Mediterranean fruit fly, *Ceratitis capitata*, to kerosine oil by Devonish[1] in 1907, petroleum oils have been the object of extensive researches as a control measure against this insect (Compere[2], Ehrhorn[3] and Severin and Severin[4]) Petroleum oils are known to attract insects belonging to very different groups , for example, coccinellids, parasitic Hymenoptera, ants, winged aphides, gnats and moths (Severin and Severin[5]) Imms and Husain[6] exposed kerosine oil on four occasions and, in one exposure, they recorded the attraction of a number of Nematocera Morgan and Crumb[7] mention the attraction of a few bees and a considerable number of large flies, principally Sarcophagidinæ, to petroleum derivatives including crude petroleum, paraffin oil and kerosine.

During an attempt to study the chemotropic responses of insects to various odorous substances at the Punjab Agricultural College, Lyallpur, India, under the guidance of Prof M. Afzal Husain, it was discovered that *Forcipomyia* sp. (Diptera, Chironomidæ) was attracted to petroleum oils in specially large numbers

In these experiments, the Minnesota fly trap (Washburn[8]) was employed The traps were hung up in fields every afternoon and brought back to the laboratory next morning, where they were fumigated with hydrocyanic acid gas and the entrapped flies counted A trap containing crude petroleum oil captured a mean weekly total of 402 examples of *Forcipomyia* from October 24 to December 31, 1924; the maximum being 1078 flies in one week, and 275 flies in a single night on November 2, 1924 During winter, the number of flies decreased rapidly and from January to March 1925, a mean weekly capture of only 9 flies was obtained. The following different *grades of petroleum oils* available in the market were also tried petrol ; kerosine oil ; crude oil used for combustion in crude oil engines ; residual oil left after the preparation of coal gas.

It was noticed that petrol which contains hydrocarbons with low boiling points was the least attractive With the view of confirming this observation a sample of kerosine oil was distilled, and fractions distilling below 80° C , at 80°–158°, 158°–184°, 184°–220°, 220°–250° and above 250° C. were separately collected and exposed as usual It was discovered that fractions distilling between 158° and 184° C attracted the largest number of flies, while those distilling below 158° C. proved to be least attractive

In almost all cases of chemotropic responses of insects, males have been attracted in much larger numbers than the females, which reduces the value of these methods as a control measure [Compare *Dacus zonatus* to citronella oil, 3 females to 1,000 males (Howlett[8]), *Ceratitis capitata* to kerosine oil, 3 females to 1,000 males (Severin and Severin[4]), *Swammerdamella* sp to cinnamic alcohol, one female to 40 males (Morgan and Crumb[9])] In the case of this chironomid, however, it is interesting to note that the females were attracted in a very great majority and constituted 91 2 per cent of all the individuals captured

TASKHIR AHMAD

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Cambridge
Feb. 6

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[1] *Sydney Morning Herald*, 645, 1907
[2] *J Agr Western Australia*, 15, 244–245, 1907
[3] *Bd Agr Forestry Circ*, 3, 1–7, 1912
[4] *J Econ Ent*, 6, 347–351, 1913
[5] *J Econ Ent*, 8, 329–338, 1915
[6] *Ann Ap Biol*, 6, 269–290, 1920
[7] *J Econ Ent*, 21, 913–920, 1928
[8] *J Econ Ent*, 5, 400–402, 1912
[9] *Trans Ent Soc Lond*, 412–418, 1912

Nicotine Spray for the Apple Sawfly

IN some preliminary experiments carried out here in 1933 by G L Hey and myself, it was found that the egg of the apple sawfly, *Hoplocampa testudinea*, Klug, can be killed by means of a spray containing 0 05 per cent nicotine and 0 5 per cent commercial soft soap

It has for some time been thought that the egg of this insect is susceptible to such a spray only shortly before eclosion, that is, after the rupture of the chorion Our experiments, however, show that the egg is vulnerable right from the time it is laid

The detailed results of these experiments, and a discussion of their practical implications, will appear in the next issue of this Station's "Annual Report"

W STEER

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Feb. 23

Mechanism of Detonation in Lead Azide Crystals

GARNER and Gomm[1] and also Muraour[2] have distinguished between the energies of activation (critical increments) which characterise (*a*) the thermal decomposition and (*b*) the detonation of an explosive In the case of lead azide, the value[1] for the detonation, 150,000 cal/mol (one extreme measurement, 9 7 sec, is omitted advisedly and with Prof. Garner's concurrence), is about *three* times that for the thermal decomposition, 47,000 cal/mol

The crystalline structure has also been examined As determined by Miles[3], the unit cell contains twelve molecules of PbN_6 In this department, however, the radiological directorate[4] has examined lead azide in more detail, the *c*-axis of Miles is doubled, giving the cell twenty-four molecules, and the space group is found to be Q_h^{18}. It follows from this that these twenty-four molecules are arranged in eight groups each containing *three* molecules of PbN_6

The recurrence of the value three is evidence that the criterion for detonation is closely related to the crystalline structure, and would indicate that the thermal decomposition is caused by the activation of a single molecule of PbN_6, whereas the detonation requires the simultaneous activation of all three constituents of one of the complex groupings $(PbN_6)_3$

T CARLTON SUTTON.

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Woolwich

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[1] Garner and Gomm, *J Chem Soc*, 2123, 1931
[2] Muraour, *Chem et Ind*, 30, 39, 1933
[3] Miles, *J Chem Soc*, 2532, 1931
[4] Unpublished

Vapour Pressure of Potassium Amalgams

IF a solution of a substance has a smaller surface tension than the pure solvent, the solute is adsorbed or concentrated at the surface, in accordance with Gibbs's theorem It is therefore to be expected that the vapour pressure of the solvent of such a solution will be higher, when the concentration of the solute is made the same in the surface as in the interior, by continually renewing the surface, than when it is not

The following facts, found by measuring the vapour pressure of mercury over potassium amalgams, by determining the absorption of the resonance line 2537 A at room temperature seem to confirm this conclusion

Diluted potassium amalgams show a much greater lowering of the vapour pressure of the mercury than would correspond with Raoult's law (an amalgam containing 1 5 atom per cent of potassium showed 30 per cent lowering of the vapour pressure) If, by careful motion, the surface is continually renewed, the vapour pressure rises almost to the value predicted by Raoult's law Soon after the motion is stopped, the vapour pressure returns to the former low value

The same phenomenon is caused by impurities in mercury which is not especially cleaned

The above results explain Pohl and Pringsheim's observations[1] on the very small dependence of the sensibility and threshold of the photo effect of potassium amalgams on the concentration

HANS H V HALBAN, JR

Physikalisches Institut
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Zurich
Feb 8

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[1] R. Pohl and P Pringsheim, *Verh Deutsch Phys Ges*, 15, 431 1913

Influence of Pressure on the Spontaneous Inflammation of Hydrocarbons

MESSRS NEUMANN AND ESTROVICH have recorded[1] some experiments on the conditions of spontaneous inflammation of the mixture $C_5H_{12} + 8\,O_2$ when heated in an iron bomb and in a bomb the inner surface of which was covered with gold The peculiar relation which they find between pressure and ignition-temperature also appears in some unpublished work of the late H B. Dixon.

In his experiments Dixon determined, at pressures ranging from 10 to 120 cm., the lag on ignition of a jet of pentane vapour heated to a predetermined temperature and issuing into an atmosphere at the same temperature. The shorter the lag, the less is the experiment liable to complications from surface effects. It is, therefore, significant that Dixon's results, as shown by the full-line curves in the accompanying illustration (Fig 1), are of the same general character as those of Neumann and Estrovich, as shown by the broken curves.

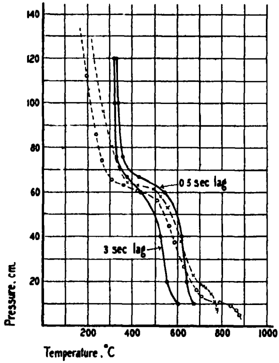

FIG 1

H F COWARD.

Safety in Mines Research Board,
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Portobello Street,
Sheffield, 1.
Feb 3

[1] NATURE, 133, 105, Jan 20, 1934.

The Velocity of Light

IN 1927 there was published in these columns[1] a table of all the determinations of the velocity of light which I compiled from the original memoirs, together with a discussion, and I pointed out that except a pair of practically simultaneous values obtained in 1882 the final values (printed in heavy type) indicate a secular decrease of velocity. The last (and lowest) value given is 299,796 ± 4 km /sec. for 1926.

Since then, two determinations have been made: the first by Karolus and Mittelstaedt (1928) using a Kerr cell, to the terminals of which an alternating potential was applied, for interrupting periodically the luminous beam, instead of a toothed wheel[2]. A frequency can be obtained in this way, of the order of a million per second, which can be accurately calculated, thus permitting a very short base to be used (41 386 metre) without any loss of accuracy. The value found (mean of 755 measurements) was 299,778 ± 20 km /sec The second recent determination is mentioned in NATURE of February 3, p. 169: it gives for the velocity of light in 1933 the value 299,774 ± 1 or 2 km /sec

The determinations of this so-called constant made during the last ten years (the most accurate of the whole series) are therefore ·

1924 .	299,802 ± 30 km./sec.
1926 ..	299,796 ± 4 km /sec.
1928	299,778 ± 20 km./sec
1933 . .	299,774 ± 1 or 2 km /sec.

No physicist, looking at the above table, can but admit that the alleged constancy of the velocity of light is absolutely unsupported by observations. As a matter of fact, the above data, treated by Cauchy's method[3], give the linear law.

$$V_{\text{km./sec}} = 299{,}900 - 4T_{(1900)\ \text{years}}$$

When I first pointed out this fact (in 1924) it was objected that the data available were inconclusive, because the probable errors of the observations were greater than the alleged rate of change Sir Arthur Eddington has dealt the death blow to the theory of errors[4] and "this theory is the last surviving stronghold of those who would reject plain fact and common sense in favour of remote deductions from unverifiable guesses, having no merit other than mathematical tractability"[5] Even "die-hards", however, may fruitfully meditate over the 2nd and the 4th values in the above table

M E. J GHEURY DE BRAY.

40 Westmount Road,
Eltham, S E.9.

[1] NATURE, 120, 603, Oct 22, 1927.
[2] *Phys Z*, 698-702, 165-167, 1929
[3] *Engineer*, Sept. 13, 1912
[4] *Proc. Phys Soc*, 271-282, 1933
[5] Dr N R Campbell, *loc cit*, 283

Graphical Determination of Contemporaries

I REGRET that Mr Dufton[1] is unable to find in my letter[2] on the above subject any clue as to what I am "trying to do", others from whom I have heard seem to have had no such difficulty.

The reproduction of Thomas Young's diagram[3] is interesting, but a diagram given by Prof Raymond Pearl in a paper[4] which he has kindly sent me gives all the information much more clearly and in such a form as to make it of real use to writers and teachers

There is no ground for the implication made by means of the quotation introduced apparently with this object only, since it is impossible by search to find matter which is quite unrelated to the title of the work in which it is included.

WILLIAM LUCAS.

9 Shanklin Road,
Crouch End, N 8.
March 2

[1] NATURE, 133, 381, March 10, 1934.
[2] NATURE, 133, 141, Jan 27, 1934.
[3] Young, T, "A Course of Lectures on Natural Philosophy and the Mechanical Arts", London, 1807
[4] "Tobias Venner and his Via Recta", *Human Biology*, 4, 565, 1932.

Research Items

Earliest known Miracle Play Mr T H Gaster describes in *Folk Lore*, vol. 44, pt 4, what he believes to be the text of a mumming play or representation in action of a ritual poem from cuneiform tablets found at Ras Shamra The text, written in a very obscure proto-Semitic dialect, describes a combat between two gods, which it is suggested was recited by priests while a religious pantomime represented the action As the tablets date from the middle of the second millennium B C, if this interpretation is correct, this would certainly be the oldest extant text of a miracle play The text describes what is apparently a ritual combat between summer and winter which is familiar in primitive and popular seasonal ritual from many parts of the world One of the gods is Aleyan-Baal, god of rains and verdure, and the other Mot or Death, god of aridity and blight The poem opens at the point where Mot has ousted Aleyan Baal from his dominion A new king is chosen and his accession to the throne is described Through the intervention of Anat, the virgin war goddess, Mot is routed, his royal garments torn from him, he is stabbed and gashed, cast into streams, fished out and finally given dominion over the underworld Aleyan-Baal is restored, the earth revives, sanctuaries are built in his honour, fires are lit for six days, and sacrifices offered In Syria, Mot, although corresponding to winter elsewhere, would be the period of drought in the summer, when all vegetation dies, and the return of Aleyan Baal would take place with the coming of rains in the autumn It is probable, therefore, that the festival at which the pantomime was performed took place at the 'New Year' in September The details of the poem correspond with the pattern of the ritual adopted throughout the world in ceremonies of 'Expelling the Death'

The Alizarin-KOH Method of Staining Vertebrate Skeletons An abstract of a preliminary note on this subject, by Mr M Rahimullah and Prof B K Das, appeared in Nature of February 4, 1933, p 171 The authors now send their published account (*J Osmania Univ Coll*, Hyderabad, Deccan, 1, 1–3, 1933), illustrated by photographs of successful preparations There is nothing of importance in this paper that is new, for the method is fairly generally used in Great Britain and in the United States, and adequate accounts are published in Gatenby's edition (1928) of Bolles Lee's "Microtomists Vade-mecum", and in the *Museums Journal*, 28, No 11, 1929 The *Museums Journal* article, by Peter Gray, states that the alizarin-KOH method is not suitable for small fish It has, however, been used with success for very small fishes by Parr and by Gloria Hollister in the United States, and by the writer of this note in Great Britain, the process often being complete in a few days Gray records alternative alcohol-alizarin methods, which are probably more suitable for permanent preparations of larval fishes. He acknowledges his indebtedness to Mr. H W Parker of the British Museum (Natural History), who was probably the first to perfect the alizarin-KOH method in Great Britain To the former abstract of the note of Rahimullah and Das it may now be added that, if the soft parts are to be dissected away from the stained skeleton, care must be taken to avoid excessive maceration in the KOH solutions A skeleton so prepared must be kept in a sealed jar of fluid (glycerin or xylol is suggested) and is not suitable for handling The authors emphasise the necessity for prolonged hardening in alcohol before using the KOH solutions

Burmese Earthworms In a paper recently received, Mr G E Gates continues his researches on Burmese earthworms, reporting on a large collection which has been carefully gathered from many little-known regions ("The Earthworms of Burma" III The Megascolecinæ *Rec Indian Mus*, **34**, Part 4 Dec 1932) 192 pages are taken up with this sub-family alone and there are more than fifty species of the genus *Pheretima* Interesting facts are shown in *Pheretima alexandri*, which is usually heavily parasitised by both nematodes and gregarines or by large numbers of spherical or ovoid cysts in the anterior portion of the body, especially in the seminal vesicles, the dorsal surface of the pharynx and the dorsal blood vessel, and part of the intestine It is found that abnormalities occur in these parasitised worms in connexion with secondary sexual characters as distinct from the gonads, the worms being quite normal externally and of the usual size The author states that the development must have progressed normally up to or nearly up to the time when the secondary organs began to develop, the cause of the abnormalities not being embryological but something that must be looked for in much later stages The subject is an interesting and important one and would probably lead to valuable results if studied in detail It is unfortunate that most tropical earthworms can only be obtained in certain seasons; for a considerable portion of the year they cannot be found, the period of drought extending in Burma from November well into June

Ghost Moths of Australia The Hepialidæ or ghost moths comprise some of the most archaic of all moths and occur in greater abundance in the isolated continent of Australia than in any other region of the globe They include some of the most gigantic and also some of the handsomest of known moths, while as caterpillars they are mostly subterranean in habit or form galleries in trees In order to obtain a true conception of the family, therefore, the Australian forms are of prime importance Mr Norman B Tindale, of the South Australian Museum, has undertaken their revision and the results of his studies are in course of publication in the *Records of the South Australian Museum* Up to date, Parts 1 and 2 have been issued during 1932 and 1933 these are well illustrated and are accompanied by careful diagrams of the venational and other characters of each genus

Root and Crown Rot of Peonies. An article on "Control of Crown and Root Rot of Peonies in America" on p 114 of the *Gardeners' Chronicle* of February 17 summarises a paper by Nellie A Brown in the American Peony Society's Bulletin Hot water treatment of peony roots has been used to combat eelworm, but will also control crown and root rot and Lemoine disease. Roots are submerged in water at a temperature of 120° F. for half an hour, but it is advisable to cut out rotten portions so far as practicable Very severely diseased plants may require treatment in two successive years, but this would disturb the plants more than most gardeners would desire.

The Limits of the Antarctic. The limits of antarctic regions have frequently been discussed. One boundary that has found some acceptance is that of floating ice, which with certain deviations makes the parallel of lat. 60° S. the approximate line. Supan suggested the mean isotherm of 10° C. of the warmest month, but inasmuch as that includes the forests of Fuegia within antarctic regions it is clearly unsuitable. Nordenskjöld, laying greater stress on the mean temperature of the coldest month, found a boundary nearer to lat. 50° S. than 60° S. and excluding all Fuegia. The mapping of the antarctic convergence in the waters of the Southern Ocean by *Discovery II* may furnish the best boundary. This change in water conditions was noted in a recent lecture to the Royal Geographical Society by Mr. Dilwyn Jones. It is the junction of the cold heavy antarctic surface water and the warm but more saline sub-antarctic surface water. The *Discovery* found that it was easily detected in all longitudes by a sharp change in temperature accompanied by corresponding climatic changes, almost equivalent to passing from winter to spring. Biologically, the convergence separates the area of *Euphausia superba* to the south from *E. Valentini* and *E. longirostris* to the north. The line runs for the most part in the latitude of about 50° S. but dips to below 60° S. in the longitude of Cape Horn.

Mexican Earthquake of January 14, 1931. Prof. J. Lacoste has made a careful study of the records of this earthquake (Pub. Bureau Cent. Séis. Intern., Monographs, fasc. No. 5, 3–58, 1933), and has prefaced it with a valuable list of 276 Mexican earthquakes during the years 1905–30. The majority of these earthquakes originated in three submarine zones, the centre of the first being in lat. 12·5° N., long. 90° W., of the second and more important in lat. 16° N., long. 97° W., and of the third in lat. 34° N., long. 118° W., all three lying along a band passing through the Acapulco Deep. The earthquake of January 14, 1931, occurred at about 6.55 p.m. and was recorded at all stations throughout the world. The shock, which lasted four minutes, destroyed completely the city of Oaxaca. Prof. Lacoste places the epicentre in lat. 15° 30′ N., long. 96° 25′ W., belonging therefore to the second of the above zones, and lying to the east of the Acapulco Deep, near the isthmus of Tehuantepec. To determine the depth of the focus, he uses Berlage's method based on the interval that elapses between the arrival of the first wave and that of the same wave reflected at the surface. The average of seven estimates is about 45 km. or 27 miles.

New Method of Photographic Photometry. In ordinary photographic photometry, the blackening of the plate is determined by passing a beam of light through the plate and measuring the absorption. A number of microphotometers have been devised for doing this. Brentano, Baxter and Cotton have recently described measurements of the light scattered by the silver particles in the photographic image (*Phil. Mag.* (Supplementary Number), February). In the experiments described, the test plates were made by exposure to X-rays, and for small densities the proportionality between X-ray exposure and scattered light was very close. Much smaller densities may be examined by this method than by absorption microphotometry, and it is therefore interesting to find that no threshold value was found for X-ray exposure before proportionality set in. The method seems very suitable for the photometry of X-ray reflections obtained in the rotation, powder, and Laue examination of crystals, for the proportionality between scattering and exposure enables the photometer to make an automatic integration of the effect over an appreciable area. It seems best to have a fine-grain emulsion and a filtered red light in the scattering photometer, using the light scattered in the range 6°–15°. Scattering from the surface of the emulsion and particularly from scratches is a serious complication, and it was found an advantage to cement a cover glass over the emulsion to reduce this scattering. The authors say that the accuracy obtained may be as good as 0·2 per cent of the limiting blackening for which proportionality can be obtained.

Attempt to Detect a Neutral Particle of Small Mass. Chadwick and Lea have recently published the negative result of an experiment designed to examine the possibility that the continuous β-ray spectrum is accompanied by the emission of penetrating neutral particles (*Proc. Camb. Phil. Soc.*, 30, Part 1). The energies of those particles might be distributed in such a way that they combine with those of the β-particles to form a constant energy of disintegration, a low energy β-particle being associated with a high energy 'neutrino'. A strong source of radium D + E + F (radium E gives a well-marked continuous β-ray spectrum) was placed near a high-pressure ionisation chamber and an absorption curve was taken with lead screens. The radiation was all identified with the radium E and polonium γ rays. If neutral particles are emitted, it is calculated that they cannot produce more than 1 ion pair in 150 kilometres path in air. A consideration of the possible nature of the particle shows that, if it exists, it must have small mass and zero magnetic moment.

Movement of Flame in Firedamp Explosions. The Safety in Mines Research Board has recently published Paper No. 82 entitled "The Movement of Flame in Firedamp Explosions" by H. F. Coward and R. V. Wheeler. The paper begins with the simplest type of firedamp explosions and goes on to more complicated cases. The scheme of the paper is that of giving the theory first and then of illustrating it by the results of various experiments. The introduction reminds us that "the lower and upper limits of inflammability of firedamp in air are roughly 5 and 14 per cent of firedamp, and that in a 9·5 per cent mixture, the so-called 'theoretical mixture', the firedamp and oxygen are in the proportions required for their complete combustion on explosion". After considering the general theory the paper goes on to discuss the propagation of flame in plain tubes, first as a uniform motion, secondly as a vibratory motion, and then describes the effects of narrow tubes, perforated plates and other types of constriction. The authors point out that the speed of propagation of a firedamp explosion may vary from zero to approximately 2,000 yd. per second, and the paper concludes with a warning that although a thorough knowledge of the theory of the subject is most helpful in interpreting any colliery explosion, the underground conditions, which in a colliery are usually exceedingly complex, must be thoroughly studied before attempting to apply the theoretical considerations set forth in this pamphlet.

Insect Pests in England and Wales*

A RECENT official report on crop pests in England and Wales covers the years 1928–31 and forms *Bulletin* 66 (1933) of the Ministry of Agriculture and Fisheries In this publication, Mr. J. C F Fryer, director of the Ministry's Plant Pathology Laboratory at Harpenden, reviews the general position over the period mentioned.

In methods of pest control, definite progress is evident with regard to enemies of fruit and other horticultural crops The English grower to-day, provided he can achieve the desired result, adopts insecticidal measures on a scale as thorough as those employed in the Dominions and the United States The progressive man realises that, to produce good sound marketable fruit, spraying is not merely an advantage, but is also an absolutely essential part of cultural routine.

In the use of dry sprays or dusts Great Britain is, however, a long way behind. It is nevertheless becoming recognised that they have definite advantages in point of ease and speed of application and reduced costs Their adoption does not seem likely to come into practice until certain initial difficulties have been overcome. Many of the improvements in control measures have resulted from investigations carried out by members of the Research and Advisory Services of the Ministry of Agriculture. New winter spray fluids have emanated from the Long Ashton Research Station

Much work has been done in connexion with pyrethrum. It has been shown that this plant can be grown satisfactorily in many parts of England. The problem as to whether the growing of the crops is an economic proposition is now being tried out. At Rothamsted, progress has been made in methods of evaluating the toxic principles found in the pyrethrum flowers. Also, experiments have been conducted with pyrethrum sprays in connexion with horticulture, which show promise, and there is little doubt that considerable developments in this direction are probable.

The entry of foreign pests through the agency of commerce, or other means, forms the second part of this *Bulletin* During the period under review the apple fruit fly (*Rhagoletis pomonella*) was detected in consignments of low grade apples from the United States Since it is a serious pest, likely to thrive under English conditions, the Ministry issued the Importation of Apples Order 1930 entirely prohibiting the entry of certain grades of apples from the United States within a specified period each year. Among other immigrant pests the cherry fruit fly, chrysanthemum midge and cottony cushion scale are briefly noticed Reference is also made to an introduced insect of a beneficial character, namely, the chalcid wasp *Aphelinus mali* This insect has proved itself at times to be capable of controlling the woolly aphis under English conditions Whether it is capable of persisting from year to year is very uncertain, and it appears to have failed in many cases owing to unfavourable climatic conditions It is therefore still doubtful whether this useful parasite can be permanently acclimatised or whether it will need to be reintroduced every few years from colonies grown under protected conditions.

The major part of the *Bulletin* is devoted to a review of the prevalence of each specific crop pest during the four years under consideration The attacks of cereal and grassland insects, for example, were, on the whole, below the average Vegetable enemies, especially root flies, caused a good deal of destruction in various parts of the country but the most serious pests were those affecting orchards Especially injurious were the apple capsid and the apple sawfly. Among strawberry pests the 'red spider' (*Tetranychus telarius*) was very destructive in 1929, when it appeared for the first time in epidemic form. in subsequent years it showed a marked decline Mention needs also to be made of the great prevalence of the aphis, *Myzus cerasi*, on cherries in Kent which was a feature in 1928 severe infestations also occurred in the south-west of England during 1931

The *Bulletin* concludes with a useful list of papers published during 1928–31 in various journals and bearing upon subjects dealt with in its pages

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* Ministry of Agriculture and Fisheries Bulletin No 66 Report on Insect Pests of Crops in England and Wales, 1928–1931 Pp vi+50 (London H M Stationery Office, 1933) 1s net

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Petrogenesis of the Newry Igneous Complex

IN her paper on "The Eastern End of the Newry Igneous Complex", which was read before the Geological Society on February 7, Miss Doris L. Reynolds made a contribution to petrogenesis of outstanding importance. The rocks described are types common to many orogenic regions, and include peridotite, biotite-pyroxenite, augite- and hypersthene-monzonite, augite-biotite-diorite and granodiorite These are convincingly shown to be derivatives, not from basaltic or granitic magmas (gabbro and granite being absent from the area), but from three primary sources, two of which have hitherto remained unsuspected. The three parental materials now recognised are (*a*) ultrabasic magmas rich in potash; (*b*) Silurian sediments which became fused by contact with the latter; (*c*) a magma represented almost entirely by plagioclase. The conclusions reached are supported by a suite of detailed analyses made by Mr. L. Theobald and Prof. H F Harwood

The earliest intrusions were peridotite and biotite-pyroxenite, the latter representing a residual magma produced by the abstraction of early-formed olivine and pyroxene from peridotite magma The ultrabasic magmas rose into graywackes and shales and became surrounded by a zone of selective fusion now represented by a fine-grained massive rock that is seen in all stages of development.

The ultrabasic magmas, which were too dense to rise by stoping, came into place partly by shouldering aside the enclosing sediments, as shown by the way in which the strike lines deviate from the regional Caledonian trend and curve round the contacts, and partly by soaking into the overlying zone of fusion, thus giving rise to augite-monzonite.

Simultaneously with, and also subsequent to, the intrusion of the ultrabasic rocks, a plagioclase magma invaded and hybridised them with the production of augite-biotite-diorite. The latter rose in turn into the zone of fusion, giving rise to hypersthene-bearing monzonites and diorites.

The granodiorite appears to have risen by stoping, since it is rich in xenoliths of the earlier hybrids and cuts across the sediments in the north-east. In places it transgresses the zone of fusion and contains xenoliths of the fused sediments. Textures and mineral and chemical composition unite in suggesting that the granodiorite is essentially a mixture of sediments and plagioclase magma with a little biotite-pyroxenite. For the most part, it clearly formed in depth and afterwards rose into its present position. The porphyritic granodiorite of Cam Lough Mountain in the west of the Complex represents the simple soaking of plagioclase magma into fused sediments.

An animated discussion followed the reading of the paper. A number of speakers, including Dr. W. Q. Kennedy, Dr. H. H. Thomas, and Mr. W. Campbell Smith, seemed suspicious about the existence of a plagioclase magma, and it was asked whether a granite magma might not be competent to produce the observed results. Miss Reynolds pointed out that since the augite-biotite diorite is a normatively undersaturated rock almost free from quartz, it is impossible that the addition of granite to the biotite-pyroxenite could have produced it. That the plagioclase came in as a magma is indicated by the observation that it has dissolved all the iron ores with which it has come into contact in the biotite-pyroxenite. From the analyses it was found that the magma is composed of about 80 per cent plagioclase, with iron ores and biotite making up the balance.

Prof. A. Holmes suggested that elsewhere there is ample evidence of plagioclase magma in the existence of anorthosites. Such magma is likely to be very hot, and by syntexis with crustal rocks it would readily grade into syenitic magma, thus providing a wide range of felspathic magmas. Questions of origin are purely speculative, but this does not mean that the plagioclase magma traced by Miss Reynolds is in any way hypothetical; its behaviour and products are demonstrable facts of observation. He welcomed the new light that the evidence from Newry will throw on the less tractable problems of volcanic fields such as that of Bufumbira. The lavas of that region include potash-rich limburgites in which he had recognised the volcanic equivalent of biotite-pyroxenite. Leucite basanites developed by the incoming of plagioclase, and by the further addition of sialic material latites and hypersthene-trachyandesites were generated.

Prof. A. Brammall pointed out that while the well-known Hollybush diorite of the Malverns might theoretically be referred to the granitisation of greenstones, neither field nor geochemical evidence sustains this view; all the evidence points to a genetic linkage with the biotite-pyroxenite that is present in the area. The formation of the diorite requires the addition to the biotite-pyroxenite of a magma composed of 60 per cent of andesine and rich in iron ores.

As illustrations of other igneous assemblages where there are signs of an ancestry comparable with that of the Newry Complex, Miss Reynolds cited the Loch Ailsh Complex of Scotland, the provinces of Monzoni and Predazzo, the Trondhjemite-Opdalite Series of Norway, the Cortlandt Series of the Appalachians and various examples in the Western Cordillera of North America, including the Rossland Complex described by Daly. She directed attention to the noteworthy fact, hitherto obscured by faulty nomenclature, that true gabbros are characteristically absent from many of the plutonic complexes of folded regions. Referring to the occurrence of monzonites and diorites as individual intrusions, Miss Reynolds suggested that hybridisation, which is known to have taken place at shallow depths, implies more intense activity at greater depths, resulting in the production of actual magmas capable of intrusion to higher levels.

Magnetic Recording and Reproducing in Broadcasting

AT the Paris Universal Exhibition of 1900, Poulsen demonstrated his telegraphone as a magnetic speech recorder for use in a telephone circuit. The apparatus, in its earliest form, consisted of a steel wire or ribbon, which was passed between the poles of an electromagnet, the windings of which were supplied with the audio frequency currents to be recorded. As the wire was drawn slowly through the field of the magnet, it received therefrom a series of transverse magnetisations corresponding to the sounds received. On the completion of the record, the process could be reversed, and by passing the steel wire between the poles of another magnet connected in series with a telephone receiver, the speech was reproduced.

Various improved forms of the apparatus were developed during the next few years, and among these was one due to Pedersen, who in 1902 succeeded in recording two telephone messages simultaneously on one steel wire, and afterwards reproducing them separately in two receivers. In general, however, the telegraphone, like many other inventions, found little application in connexion with communication technique, until it was given a new lease of life by the introduction of broadcasting.

It is now several years since the Blattnerphone, a modern form of this magnetic recorder, was introduced for recording speech and sections of programmes required for broadcasting purposes. It soon became apparent that the magnetic recording system had important advantages over the use of films or wax discs for this purpose. Among these advantages are the freedom from chemical processes, and from delicate mechanical adjustments, and also the facility with which the recording strip can be 'cleaned up' for repeated use.

The latest form of this apparatus for commercial use in Great Britain, known as the Marconi-Stille equipment, formed the subject of an article in the *Wireless World* of January 5, and was also demonstrated by Marconi's Wireless Telegraph Company, Ltd. at the recent Physical Society's exhibition. The Marconi-Stille machine provides an uninterrupted record of thirty-five minutes duration, and it incorporates the necessary mechanism for driving the steel tape at a uniform speed through the electromagnetic apparatus, which produces a varying magnetic flux in the tape in the case of recording, or translates the magnetic record into currents of varying amplitude for reproduction purposes. The steel tape is driven by synchronous motors at a normal speed of 90 metres per minute, between two drums similar to those used in a cinematograph film projector In its passage the tape passes in succession through three pairs of special bi-polar electromagnets, which are used in turn for 'wiping-out' any previous record, for recording and for reproducing The heads carrying the two latter sets of magnets are provided with micrometer adjustments for controlling the separation of the pole pieces, since this adjustment affects the response characteristics The three heads of the apparatus are connected by screened twin leads to their appropriate places on the amplifying and control panels, and means are provided for obtaining the correct level required for recording and reproduction. The recording magnet is also supplied with auxiliary direct current to operate the tape at the best part of the magnetisation characteristic for recording A suitable audio-frequency correcting circuit is connected in the reproducing amplifier, and the proximity of the recording and reproducing heads on the apparatus enables an instantaneous comparison to be made between the input signals and the output from the equipment

The magnetic record, once made, is permanent and may be utilised any number of times until it is wiped out by the demagnetising process for use on another programme. The whole process now finds widespread application in broadcasting services, particularly for the relaying of important or interesting programmes at different times

University and Educational Intelligence

CAMBRIDGE —J. Yudkin, of Christ's College, has been appointed to the Benn W Levy research studentship in biochemistry

Smith's prizes have been awarded to the following candidates : K Mitchell, of Peterhouse, and A J Ward, of Emmanuel College

Rayleigh prizes have been awarded to M S Bartlett, of Queen's College, and C G Pendse, of Downing College.

Grants from the Worts Fund have been made as follows :—£50 to N Bachtin towards the expense of a journey to North Thessaly, £50 to I. H. Cox towards his expenses as geologist in the Parry Islands, £50 to J J Keigwin towards the expenses of an expedition to the Zambezi Valley, £50 to P W. Richards towards the expense of a botanical expedition to South Nigeria, £40 to W Graham-Smith for palæontological investigations in Canada, £25 to C. W Borgmann for metallurgical research in Sweden, £25 to J W. S. Pringle towards the expenses of the Cambridge Freshwater Biological Expedition to South Morocco, £10 to J W. Welch for expenses in connexion with his study of the Qaoko tribe.

The managers of the Balfour Fund have made a grant of £50 to C Forster-Cooper, of Trinity Hall, for researches on the fauna of the Achenarass Quarries.

J. H. Lochhead, of Christ's College, has been nominated to use the University's table at the Zoological Station at Naples from April 1 until September 30, 1934.

LEEDS —The Vice-Chancellor, on behalf of some two hundred subscribers, presented on March 9 to Prof. Walter Garstang a radiogramophone and a cheque, as a token of appreciation from colleagues, pupils and other friends at Plymouth, Oxford, Lowestoft and Leeds Prof Garstang retired from the chair of zoology last year

LONDON —The following degrees have recently been awarded . D Sc (Econ) to A E Feavearyear (private study) for two published works entitled "The Pound Sterling A History of English Money", and "Spending the National Income" and D Sc in physics to W. E Williams (recognised teacher at King's College) for ten works on interferometry.

SHEFFIELD —The following appointments have been made Dr E J Wayne, to the chair of pharmacology , Dr James Clark, to the lectureship in infectious diseases , Mr H Laithwaite, as junior research assistant in the Department of Glass Technology

THE Board of Education is prepared to consider applications for full-time studentships from teachers with at least five years' teaching experience who desire financial assistance to follow courses of advanced study at universities or other institutions at home or abroad Particulars of the awards and application forms are obtainable from the Board of Education, Whitehall, S W 1

Science News a Century Ago

Capt. John Ross Honoured

In 1829, thanks to the generosity of Sheriff Felix Booth, Capt John Ross had been able to fit out the steam vessel *Victory* for arctic exploration Ross sailed in May 1829 and returned home in October 1833 in the *Isabella*, the *Victory* having had to be abandoned in the ice On March 27, 1834, at a Court of Common Council, Ross was presented with the freedom of the City of London. In making the presentation, Sir James Shaw, the Chamberlain of the City, said "Captain Ross—The City of London have ever been forward in bestowing the honour of their freedom on eminent men who have distinguished themselves in the service of the public In your person science has been largely and specially indebted for the zeal, public spirit and disinterestedness shown by you in fitting out and taking charge of an expedition, with the patriotic view to the solution of the problem whether a north-west passage existed to the Pacific. For the courage and perseverance which have marked the whole of your proceedings in this hazardous enterprise, and for the admirable skill and address manifested by you, with the blessing of Heaven, in preserving life and health and harmony amongst your brave companions, amidst the privations and hardships of four years' navigation in the Arctic regions ,—for these services the Corporation of London have recorded their grateful thanks by presenting you with the freedom of their ancient city in a box of British oak."

J. D. Forbes at Edinburgh

When J. D. Forbes in 1833 was appointed to succeed Sir John Leslie as professor of natural philosophy in the University of Edinburgh, he was not twenty-four years of age and had held no appointment before When preparing his lectures, he wrote to Whewell for advice on various points, especially in regard to textbooks, for he felt that the textbooks used at Cambridge would be useless for his class at Edinburgh, owing to the then low state of mathematical knowledge among Scottish students. He consulted Whewell on many points in natural philosophy and mechanics, and towards the close of his first session, on March 29, 1834, wrote to Whewell: "I find the greatest advantage from having been obliged to study these subjects in a way necessary to convey a precise idea of them to others, which I feel that almost no other circumstance would have induced me to spend so much labour upon. . . A month hence, I shall have finished my course, and then propose to escape for a little relaxation. I shall probably go to London, and hope to see you. I am certainly relieved at having got well through so much of my course. The responsibility I felt was oppressive. But my labours have been more than rewarded by the efforts of my pupils, and the obvious improvement in the method and degree of study which has been the consequence. I have given about twenty lectures to the more advanced, going as far as 'Poisson's Demonstration of the Direct Problem of Central Forces', which, humble as it may appear to you, is a step among us 'hyperborean sages'."

Steam Road Carriages

In the first third of last century, steam road carriages were made by many inventors, including Trevithick, Gurney, Hancock, Church, James, Squire, Maceroni and Dance, and some of the vehicles were used for regular passenger services. Two other pioneers were Richard Roberts and John Scott Russell. A carriage made by Roberts made an experimental trip in December 1833, followed by a second three months later. On March 29, 1834, the *Manchester Advertiser* said, "on Thursday the carriage started from the works in Falkner-street at half-past six in the evening under the guidance of Mr. Roberts, with upwards of forty passengers. It proceeded about a mile and a half up Oxford-road, namely, to near the end of Nelson-street, where owing to an apprehension of a deficiency of water, a sudden turn was made. The breadth of the road at this point was insufficient to allow of free scope for the engine, and about six minutes were occupied in making the turn. The carriage then proceeded back to the works where it arrived without accident just nineteen minutes after starting. The maximum speed on a level was twenty miles per hour." On April 4 the carriage was taken out again, but the trial was stopped through the failure of the boiler tubes.

Of Russell's carriage the *Weekly Dispatch* of March 30 said: "A new steam-carriage [Mr. Russell's] commenced plying between Glasgow and Paisley on Wednesday. The carriage is attended by a supplementary vehicle containing the necessary supply of charcoal and water. The carriage is superbly fitted up, holds six inside and twenty outside passengers, and is hung upon springs, quite free of the boiler and machinery. The boiler is extremely small and occupies the space immediately below the carriage while the boot contains the engines. The boiler is capable of generating steam in twenty minutes. The two engines fourteen horse power each situated above the hind axle are connected with it by cranks working at right angles to one another so as to produce continuous rotary motion."

Societies and Academies

London

Institute of Metals (Annual General Meeting), March 7. G. A. HANKINS and C. W. ALDOUS: Minimum dimensions of test samples for Brinell and diamond pyramid hardness tests. The metals investigated include copper, brass, aluminium and steel. A width of test-specimen of 4½ times the diameter of the impression is satisfactory for accurate Brinell tests. For Brinell tests, the limiting value of the ratio of thickness of test sample to depth of impression for accurate results appears to be a characteristic of the test material; a value of the ratio of 6 is required for mild steel, about 15 for copper and more than 20 for spring steel. For diamond pyramid hardness tests a limiting value of the ratio of test-sample thickness to impression diagonal of 1½ gives results which are practically independent of test-sample thickness except with soft copper and soft brass. I. G. SLATER: Note on the influence of gases in an 8 per cent copper-aluminium alloy on normal and inverse segregation. In a sand-cast ingot, 3 in. in diameter by 3 in., segregation is inverse with very gassy melts but normal with degassed melts. GILBERT RIGG: The diffusion of zinc and iron at temperatures below the melting point of zinc. When clean rolled zinc sheet is heated in close contact with clean iron, diffusion commences at below 300° C. and is fairly rapid at above 380° C.; it proceeds by the formation of cones of diffusion products, which spread out from isolated points where the contact between the metals is most perfect, and gradually penetrate into the zinc and across its surface. Two well-defined layers of diffusion products are formed, a thin layer of constant thickness (about 0·08 mm.) containing about 17 per cent iron being next to the iron, and a thicker layer containing 0–11 per cent iron outside this. On continued heating, the thin layer moves towards the zinc, being continuously converted into the zinc-rich layer; this would seem to indicate that the principal diffusion constituent is the iron. H. G. GOUGH, H. L. COX and D. G. SOPWITH: A study of the influence of the intercrystalline boundary on fatigue characteristics. With the object of studying the process of fatigue in relation to crystalline boundaries, tests under alternating torsional stresses have been made on three specimens of aluminium each consisting of two crystals. The distribution of slip bands showed that the effect of the boundaries on the distribution of stress was extremely slight, each crystal of each specimen behaving as if it alone composed the whole specimen. It appears that the presence of intercrystalline boundaries may considerably strengthen the constituent crystals against fatigue; but that the effect of the boundaries on the distribution or even on the amount of slip is very small. It is probable that the major effect of the boundary may lie in some restriction of strain that it imposes. C. E. PEARSON: The viscous properties of extruded eutectic alloys of lead-tin and bismuth-tin. Elongations up to 2,000 per cent have been obtained in tensile tests employing prolonged loading. An apparatus designed to maintain a constant stress on the test-piece during extension shows that deformation takes place at a uniform rate which is greatest in freshly extruded rods and decreases with age or on annealing. The viscosity is not that of simple liquids, but resembles that shown by some disperse systems in which the viscosity coefficient is a function of the stress causing flow. The locus of viscous flow is found to be at the intercrystalline boundaries. E. W. Fell : A note on some formulæ concerning viscous and plastic flow in soft metals In particular, the flow of the metal in a prolonged ball-hardness test is compared with the flow in tensile test-pieces under a constant stress per unit area of cross-section. A. Portevin and P Bastien : Castability of ternary alloys. The ability of a molten metal or alloy to fill a mould completely is termed 'castability'; it can be determined by ascertaining the length of a spiral cast-iron mould filled by the metal under predetermined casting conditions. The castability of a pure metal is a linear function of the difference between the pouring temperature θ and the melting point F; the slopes of the castability $(\theta - F)$ curves vary with the viscosity of the metal. The castability of binary alloys varies with the solidification range and with the mode of crystallisation, being greater when polyhedral crystals separate than when the primary crystals are dendritic. Maximum castability occurs with the eutectic composition and minimum at the limit of solid solubility The castability of ternary alloys generally varies inversely with the primary solidification range.

PARIS

Academy of Sciences, January 29 (*C.R.*, 198, 409–512) E Jouguet : Generalisation of the problem of the refraction of adiabatics. Armand de Gramont and Daniel Beretzki : A property of triode valves. Charles Nicolle, Paul Giroud and Mme. Hélène Sparrow : The exceptional presence of the murin virus in the urine of rats experimentally infected with this virus In two experiments out of ninety-three, positive results of infection by urine were obtained Louis Roy . The focal image of stars. Mme Hilda Geiringer : A general method of theoretical statistics. Francesco Severi . The general theory of correspondences between two algebraic surfaces. Paul Lévy : A generalisation of Rolle's theorem. M Haimovici : Fundamental formulæ in the theory of hypersurfaces of a Finsler space Robert Gibrat The solutions of a fairly general class of singular integral equations. Jean Leray and Alexandre Weinstein : A problem of conformal representation set by the theory of Helmholtz. Paul Boisseau : New integraphs and differentiators. P. Sonier : Charged and compressed thin plates. E. Crausse : Contribution to the study of the vibration of a metallic tube immersed in a liquid in a transitory state C. Popovici The analytical explanation of air pockets. W M. Elsasser . The equations of motion of a neutron N. Saltykow · The canonical transformation of Lagrange equations on the movement of several bodies. J. Ellsworth : The variation of the period of the double system, R. Canis Majoris, with eclipses. Supplementing the theory of Tisserand with the effect of aberration, the spectroscopic and photometric results can be satisfactorily explained. Florian La Porte : The use of radiogoniometric bearings at a great distance. E Barrillon . Geometry of the vessel. Extension of the metacentric method by the use of metacentric sections. Al. Proca : The quantic mechanics of photons. Pauli's approximation. L. Goldstein : The theory of elementary corpuscles. Eligio Perucca : The conductivity of metallic films in an electric field. Using extremely thin films of gold and platinum, deposited by cathode sputtering on quartz threads, variations of resistance with variations of an external electric field were measured. For certain thicknesses of film the change in resistance amounted to 40 per cent. Ch. Lavanchy : A general method for calculating high voltage electrical networks interconnected in a state of permanent equilibrium G Carpeniseanu · The anodic oxidation of the lactic ion to the pyruvic ion. Study of the conditions under which the anodic oxidation of sodium lactate to pyruvate can take place The yields of pyruvate are always small. Léon Capdecomme The use of vacuum cells for the comparison of feeble light intensities Guy Emschwiller : The chemical action of light on vinyl iodide. Vinyl iodide on photolysis gives acetylene, ethylene and iodine as primary products. In the presence of oxygen, besides iodine, formic acid, formaldehyde, glycollic aldehyde, carbon monoxide and dioxide and some acetylene are produced Jean Louis Destouches Theoretical remarks on the emission of corpuscular rays (β-rays or positrons) and on the symmetry between corpuscles and anticorpuscles L. Domange : The densities of aqueous solutions of hydrofluoric acid The determinations were made in a gravity bottle of bakelite, a material which was proved to be unattacked by the acid Data are given for twelve strengths of acid between 5 and 54 per cent E Canals, Mlle. G Cauquil and P. Peyrot The molecular diffusion of light in liquids. Jules Guéron . The hydrolysis of solutions of stannic chloride R Charonnat and L. Deglaude The criteria of purity of crystallised digitaline (digitoxoside) The authors regard the specific rotatory power as the best criterion of purity G Darzens and Maxence Meyer . New methods of preparation of diethoxyacetone and the β-substituted *αα*-diethylines. Marcel Godchot, Max Mousseron and Robert Granger The action of hypochlorous acid on active 1-methyl-Δ_3-cyclohexene. René Jacquemain Some tertiary alcohols derived from mesityl oxide V. Lebedeff and G Choubert : New observations on the minerals of Niari (A E.F.) basin. L. Barrabé The outcrop of the ancient base of the Petites Antilles in the island of Désirade (Guadeloupe) J. Blayac, A. Michel-Lévy and M. Thoral A basic conglomerate in the Cambrian of the Monts de Lacaune and on the pre-Cambrian age of the granitic formations of the Mendic near Graissessac (Hérault). C Dauzère and J Bouget . The variations of the conductivity of the air in caves Although the temperature and hygrometric state of the air in caves remain very nearly constant, the electrical conductivity of the air undergoes variations of considerable amplitude J Gauzit . The study of the atmospheric ozone at the Pic du Midi by direct vision of the sun at the horizon The data given were based on spectrophotometric observations. Hubert Garrigue The radioactivity of the air of the house at the Observatory of the Pic du Midi Léon Lemmel : The spectroscopic study of the wood of the "Pino Sylvestre" of Rascafria (Spain). In addition to the elements which would be expected, the presence of boron, lead and silver was proved Georges Deflandre . The existence on the flagellæ of lateral or terminal filaments (mastigonemes). Herbert H Jasper and André Pezard : The relation between the rapidity of a striated muscle and its histological structure. J Vellard, Oswino Penna and Miguelote Vianna . The comparative action of the poisons of *Lachesis atrox* and of *Naja tripudians* in experimental sarcoma in the rat. P. Bruère . Proportions and distribution of manganese in the grain of wheat. Théodore Posternak A hexose phosphoric acid obtained by the hydrolysis of starch. G Ramon and E Lemétayer · Infectious anæmia of the horse Marcenac : The anthelmintic power of certain chlorine compounds of butane in cylicostomosis of the horse. Dichlorbutane and chlorobutene have powerful anthelmintic properties and possess advantages over other products usually prescribed for the treatment of cylicostomosis of the horse

Copenhagen

Royal Danish Academy of Sciences and Letters, Oct 20. Th Mortensen The marine fauna of St Helena It is demonstrated through the study particularly of the echinoderms, based on collections made during investigations at St Helena in 1929, that the marine fauna of the island originated from three different sources North Africa–Mediterranean, West Indies –Brazil, and South Africa–Indian Ocean, the various forms having been transported to the island by means of currents, either as pelagic larvæ or as adults, on floating Algæ The island has never been in connexion with either Africa or South America. The statements of the existence of manatees at St Helena in recent or pleistocene times—which would seem to prove the existence of former land-connexion —rest on misapplication of the name 'manatee' to sea-lions (see also Nature, March 17, p 417)

November 17 Johs Lindhard The so-called muscle action current experiments on individual muscle fibres show that the action current does not occur when separate fibres are directly stimulated On the other hand, when the motor end plates are directly stimulated, whether in normal combination with undamaged muscle fibres, or separated from the main mass of fibres, the action current occurs

December 2. Harald Bohr . The uniform convergence of Fourier series A general theorem concerning integration of exponential-polynomials

January 12 Elis Strömgren The use of purely mathematical and of numerical methods in the problem of three bodies.

Forthcoming Events

Monday, March 26

Victoria Institute, at 4 30 —G R Gair "The Cradle of Mankind".

Royal Geographical Society, at 5 30 —"A Survey Ship on the Coast of Labrador" (Geographical Film)

Tuesday, March 27

Royal Aeronautical Society, at 6 30 —Annual General Meeting.

Royal Society of Arts, at 4 30 —Miss Margery Perham "Some Problems of Indirect Rule in Tropical Africa" (Joint Meeting with the African Society)

Wednesday, March 28

Royal Meteorological Society, at 5 30 —Prof W. Schmidt . "Micro-Climatological Work in Austria"

Official Publications Received

Great Britain and Ireland

University of Leeds Twenty-ninth Report, 1932–33 Pp 160. Publications and Abstracts of Theses by Members of the University during Session 1932–33 Pp 31 (Leeds)

Ministry of Health · Advisory Committee on the Welfare of the Blind Handbook on the Welfare of the Blind in England and Wales Revised edition Pp iv+50 (London H.M. Stationery Office) 1s net.

Empire Cotton Growing Corporation Reports received from Experimental Stations, 1932–1933 Pp xi+234 (London Empire Cotton Growing Corporation) 2s 6d

The Scientific Proceedings of the Royal Dublin Society Vol 21 (N S), No 5 The Oxidation of Hydrazine by Potassium Ferricyanide, Part 1 · The Influence of Gaseous Supersaturation on the Measurement of Reaction Velocity , Part 2 The Reaction in Presence of Acetone By Thomas Norman Richardson and Dr Kenneth Claude Bailey Pp 43-56 (Dublin Hodges, Figgis and Co , London Williams and Norgate, Ltd) 1s

Ministry of Health Report to the Minister of Health by the Departmental Committee on Qualifications, Recruitment, Training and Promotion of Local Government Officers Pp 91 (London H M Stationery Office) 1s 6d net

The National Institute of Agricultural Botany Fourteenth Report and Accounts, 1932 33 Pp 19 (Cambridge)

Other Countries

Canada Department of Mines Mines Branch Anthracite and Coke Analysis Survey conducted at the Fuel Research Laboratories (No 737–5) Pp 13 (Ottawa King's Printer)

Commonwealth of Australia Council for Scientific and Industrial Research Pamphlet No 47 Properties of Australian Timbers Part 1 Eight Timbers of the Genus *Eucalyptus* (Ash Group) Collated and edited by H E Dadswell (Division of Forest Products Technical Paper No 13) Pp 28+10 plates (Melbourne Government Printer)

U S Department of the Interior Geological Survey Water Supply Paper 727 Surface Water Supply of the United States, 1932 Part 2 South Atlantic Slope and Eastern Gulf of Mexico Basins Pp vii+221 15 cents Water-Supply Paper 731 Surface Water Supply of the United States, 1932 Part 6 Missouri River Basin Pp x+349. 20 cents Water-Supply Paper 733 Surface Water Supply of the United States, 1932 Part 8 Western Gulf of Mexico Basins Pp vi+197 15 cents Water Supply Paper 739 Surface Water Supply of the United States, 1932 Part 12 North Pacific Slope Basins C Pacific Slope Drainage Basins in Oregon and Lower Columbia River Basin Pp vi+167 15 cents (Washington, D C Government Printing Office)

Cornell University Agricultural Experiment Station Bulletin 577 The Rate of Photosynthesis of Apple Leaves under Natural Conditions, Part 1 By A J Heinicke and M B Hoffman Pp 32 Bulletin 578 · The Effect of Different Planes of Protein Intake upon Milk Production 2 Further Comparisons of 16-, 20- and 24- per cent Mixtures. By E S Harrison, E S Savage and S H Work Pp 12 Bulletin 579 The Diagnosis and Control of Mastitis By D H Udall and S D Johnson Pp 15 Memoir 150 Biochemistry and Biophysics of the Developing Hen's Egg 2 Influence of Composition of Air By Alexis L Romanoff and Anastasia J Romanoff Pp 36 (Ithaca, N Y)

Bergens Museum Årsberetning, 1932–1933 Pp 90 Årbok, 1933 Hefte 2 Naturvidenskapelig rekke Pp 255+5 (Bergen A S John Griegs Boktrykkeri)

Fiskeridirektoratets Skrifter, Serie Havundersøkelser (Reports on Norwegian Fishery and Marine Investigations) Vol 4, No 4 On the Age and Growth of the Pollack (*Gadus pollachius* L) from the Norwegian Skagerrack Coast By Alf Dannevig and Adolf Sørensen Pp 15 Vol 4, No 5 Nogen iakttagelser over fiskeyngel i trålfangster i Barentshavet Av Thor Iversen Pp 12 Vol 4, No 6 A Norwegian Fat Herring Fjord , an Oceanographical Study of the Eidsfjord By Jens Eggvin Pp 22 Vol 4, No 7 Torsken og Fiskehavet 1933 (The Cod and the Sea in 1933) Pp 27+1 plate (Bergen A S John Griegs Boktrykkeri)

Science Reports of the Tokyo Bunrika Daigaku, Section B No 15 The Herpetological Fauna in the Vicinity of Nikkô, Japan By Yaichirô Okado Pp 159–173 30 sen No 16 · Habitat Notes on the Freshwater Pearl-Mussel, *Margaritana margaritifera* (Linné) in Hokkaidô, Japan By Kazuo Koba Pp 175–180 15 sen No 17 Über einige neue Ciliaten aus dem Darmkanal von japanischen Echinoideen (1) Von Mitsuo Uyemura. Pp 181–191 20 sen No 18 On the Syngamy of some Myxomycetes By Seiji Abe Pp 193–202 15 sen (Tokyo Maruzen Co , Ltd)

Fiftieth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1932–1933 Pp 7 (Washington, D C Smithsonian Institution)

The Parliament of the Commonwealth of Australia, 1932–33 Seventh Annual Report of the Council for Scientific and Industrial Research for the Year ended 30th June 1933 Pp 87 (Canberra Commonwealth Government Printer) 3s 8d

Catalogues

Special Sale Catalogue of Important Journals and Periodicals (Scientific, Technical, Medical, Economic) Pp 20 (London Oppenheim and Co (Rare Books), Ltd)

Periodica, Iconographia, Rara et Curiosa (No 85) Pp 62 (Berlin W Junk)

A Catalogue of Books and Periodicals on Botany. (No 485) Pp 64 (London . Bernard Quaritch, Ltd)

Murby's Maps and Models for Geology, including Models of Extinct Vertebrates Pp 16 (London Thomas Murby and Co)

Bright Annealing by the O R P (Oxide Reduction) Process Pp 4 (London Wild-Barfield Electric Furnaces, Ltd)

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Prices of Scientific Books

THERE are few libraries of scientific books, whether they be those of universities or other institutions or of private individuals, which have not been compelled during the last few years to cut down their expenditure upon periodicals The loss is a loss to the library, to the scientific worker, and to the publisher, and has increased on the library shelves the much detested 'broken series'. Really the outcry on behalf of continuing old established series of periodicals may be more sentimental than rational ; it is impracticable and impossible for any institution to continue all the old series and add all the new, and there is no sufficient reason why an old periodical should be continued if it has degenerated in quality or if it can be replaced by one better suited to the needs of the users of the library Co-operation between libraries will often solve the problem of retaining the fullest possible range by avoiding duplication of the least necessary series

The question, however, arises and is pressing. Since libraries must cut down expenditure upon periodicals, could a cut be organised which will have some effect in nullifying the conditions against which the libraries are struggling ? We think it could

Amongst many other services, the American *Quarterly Review of Biology* performs the annual service of analysing the cost of biological books received for review by that journal The result of John R Miner's analysis is always illuminating, sometimes astounding, and has been referred to on more than one occasion in the pages of NATURE For 1933 the number of pages reviewed by the *Quarterly Review* was 104,725, and the comparisons are worked out on the average cost per page to the reader, the prices of foreign books having been converted into dollars at the rate current when the book was received

In the first place it is satisfactory to notice that the general trend of prices continues to be downwards , thus a decrease of 3·6 per cent from 1932 to 1933, and of 8·9 per cent from 1926 to 1933, has brought the average price of all the books reviewed to 1·005 cents a page This is in accord with the falling price of commodities in general throughout the world, but it is not so satisfactory to learn that the fall in price of biological books has lagged seriously behind the international decline "Thus the books published in the United States show a decrease in price of 8·9 per cent from 1926 to 1933, whereas the wholesale commodity price index of the United States Bureau of Labor Statistics declined about 40 per cent in the same period." The most striking decline in price has been in the books published in England (by which we imagine the author means Great Britain, for Scotland is by no means negligible as a producer of biological works), and there the fall from 0·89 to 0·66 cents a page represents more than 25 per cent. Since this difference, as converted into dollars, probably reflects the change in the relative value of the pound sterling, it is sad that we on this side of the Atlantic cannot appreciate it in buying our own books.

In the second place, it is noticeable that in spite of certain readjustments of price, a very marked discrepancy still exists between the prices of books published in different countries. Since the price comparison began in 1926, France has, until 1933, held pride of place for the cheapest commercially produced scientific books, but in 1933, with an addition to cost of 23·3 per cent, the price of 0·74 cents a page exceeds the cost of British books, which now are cheapest in the list.

We have not included in this comparison non-commercial books, such as Government publications the primary purpose of which is presumably propaganda for the good of the nation as a whole, for which end they are subsidised. Comparison of prices throws some light upon the value placed by governments upon the value of scientific work. U.S. Government publications are by far the cheapest in the whole list of publications, at 0·17 cents a page, for the encouragement of the application of scientific results, whereas the cost of British Government publications is 1·39 cents a page, *more than twice the price of commercial books*, and approaching very near to the cost of German books, which are the most expensive in the list. It would seem that either H.M. Stationery Office is inefficient as a producer of books, or that our Government does not consider the results of the work of its scientific staffs sufficiently valuable to be set before the public in the way deemed desirable in the United States. We suspect the presence of both adverse influences; but in any event it is difficult to understand why there should be this difference between the commercial price of British scientific books and the British Government price.

As to the discrepancy between the book prices of different countries: in 1933, while the French price rose 23 per cent, the German price fell 10 per cent, and yet in spite of that readjustment the price of German books is almost double that of French, 1·43 cents against 0·74 cents a page. The German prices for medical and scientific publications are so great in comparison with those of other countries (except British Government publications) that probably every scientific institution in the world has been discussing the matter as one of the serious library problems it has to face. There are several disturbing features. So great is the discrepancy that in most libraries of reasonable size a very large proportion of the annual grant for periodicals (two thirds or more in U.S.A. libraries) is swallowed up by expensive German publications chiefly in the hands of one or two large firms, leaving a third or less for periodicals from the rest of the world. That proportion clearly bears no relationship to the relative scientific value of the journals in question.

"The cost of some of these journals has now reached as high as 90·00 to 173·00 dollars a year, and as no definite yearly subscription price is announced, the subscriber cannot know beforehand what he will be called upon to pay." There is a remedy; it is a drastic one, but after mature consideration it has been adopted and recommended by the Medical Library Association, on the advice of a special committee which it appointed to inquire into the situation.

We quote in full the resolutions, as passed by the Association (*Science*, 78, 139; 1933), they may be helpful to the curators of libraries of scientific periodicals in Great Britain, suggesting that by co-operation an end may be put to what is no less than extortion, an exploiting of scientific workers, because of their desire to give due weight to the scientific results of every country.

"1. It is recommended that no library subscribe to any periodicals that do not have a fixed annual subscription price for the entire annual output of volumes or parts. That such price be stated in advance, and also a statement of the number and parts to be issued per year.

"2. That the Committee on the Cost of Current Medical Periodicals be empowered to invite the various library groups of this and other countries to co-operate with us in the above-mentioned and other measures, necessary to establish more equitable prices for medical and other scientific journals, and that the approach to library organizations in other countries be made first through the president of the International Federation of Library Associations.

"3. We believe there is a widespread opinion that there must be a substantial reduction in extent of, and in subscription prices for, the most expensive medical and other scientific periodicals,

> and we further recommend that, unless definite word to this effect is received prior to renewal of subscriptions for 1934, libraries cancel their subscriptions to the most expensive journals, except one library in each of 6 to 10 zones throughout the United States and Canada "

Some of our British universities have found the strain of German periodical subscriptions to be so great that they have already drastically cut down the list But isolated action penalises the pioneers and may not be sufficiently cumulative to have the effect desired , whereas co-operative action, even throughout the English-speaking world, could scarcely fail to bring about a more reasonable attitude on the part of the publishers concerned

J R

Protozoology in the United States

The Biology of the Protozoa By Prof Gary N Calkins Second edition, thoroughly revised Pp xii+607+2 plates (London Baillière, Tindall and Cox, 1933) 37*s* 6*d*

THE first edition of this book appeared in 1926, and was favourably reviewed in these pages at the time (NATURE, 118, 763, Nov 27, 1926) by another hand and since this new version is described as "thoroughly revised", one turns to it with confident hope that the shortcomings of the earlier volume have been, in the main, remedied According to the author's preface, the chief amendments are as follows

> "After the first introductory chapter we plunge at once in Chapter II into the substances and structures of the fundamental organization This is followed . by the development of those substances and structures into cytological derivatives (Chapter III) and taxonomic structures (Chapter IV) of the derived organization In Chapter V the general physiological activities are considered in anticipation of Chapter VI on reproduction. The problem of general vitality and its significance in fertilization and the accompanying phenomena of sex differentiation, maturation, reorganization, adaptation and variations are treated in Chapters VII, VIII and IX The special chapters on taxonomy, together with more elaborate keys to genera, are transferred from the middle of the book to the end in Chapters XI, XII, XIII and XIV."

This second edition also contains a new chapter entitled "General Ecology, Commensalism and Parasitism" As the author truly says, "Parasitism and disease should be considered in any work on general biology These topics were omitted in the first edition but are introduced here in Chapter X". In this chapter is included a discussion of the dysentery amœba of man (*Entamœba histolytica*), in the course of which the author insinuates that the present reviewer comes "rather close to unfair dealing" in his interpretations of history and nomenclature This charge should be answered at once, as it has already been singled out for commendation in the United States But it will suffice to note that Calkins's other allegations are here often clearly incorrect, and his conclusions demonstrably wrong For example, he tells us that Losch, in his classical case of amœbic dysentery, "found an abscess of the liver containing amebæ" . he gives Councilman and Lafleur credit for modern views which they did not express and he concludes, apparently, that the correct name of the parasite in question is "*Endamœba dysenteriæ* (*histolytica*)"—an unorthodox combination in which every term appears to be unjustifiable It may be noted further, as evidence of the author's own fairness and impartiality, that he finally assigns the reviewer s discovery of the complete life-cycle of the parasite *in vitro* to two later American imitators Calkins is obviously unfamiliar with this branch of his subject, and his excursion into it seems therefore regrettable

Unfortunately, many other pages in this book invite similar criticism The "thorough revision" which it has undergone has neither brought it reasonably up to date nor corrected scores of factual mistakes in the first edition and its precursors Proper names are still too often misspelled, or printed without their diacritical marks no magnifications are noted for most of the figures, so that composite pictures are likely to delude the uninstructed (for example, Fig 4, p. 23, where a *Chilomastix* cyst appears as large as an adult *Euglypha*) it is scarcely ever indicated whether the illustrations show living or fixed and stained specimens the fabulous figures of "mitosis in *Endamœba coli*" (Fig 26, p 53—rightly claimed as "original") are still unblushingly displayed · and the bibliography is still carelessly done and unrepresentative Many authors are hardly treated, and the references as a whole are still inadequate As an example, it may be noted that Wenyon, our leading protozoologist—whose name was omitted altogether from the "Bibliography" in the first edition—is now credited with only two publications, both bibliographically inexact. Most other living English protozoologists are ignored The "more elaborate keys to genera", so far as we have tested them in detail, seem more likely to mislead than to direct the beginner—for whom they are presumably intended

Some of the defects just noted are doubtless to be excused as survivals from earlier publications, yet even so it is hard to understand how they have escaped a reviser's eye. But Calkins is nothing if not conservative In 1901 he called the Father of Protozoology "Anton von Leeuwenhoek"—as though he were a German—and he called Ledermuller "Ledenmüller", and in 1933 he does so still. On the other hand, it should be added that both text and illustrations have now been slightly curtailed, while two coloured plates—borrowed from others—have been incorporated but there is also now only a single index (19 pages) instead of the separate author and subject indexes (25 pages in all) in the first edition, though the price has been increased by approximately 7 per cent

Errors in detail are present in every book ever printed, and we have no desire to lay undue emphasis on a few glaringly exhibited in the work under review A book may be good in general, though bad in particulars and the present volume must therefore be considered and judged also from a wider angle Yet this is very difficult, because—despite its rearrangements, additions, and corrections—no rational plan seems to underlie the work as a whole It seems still to be a medley of morphology, systematics, and physiology, precariously held together by loose generalities, while the very title, with its undefined term "biology", is apt to mislead us regarding the author's aim—if any But it is "unfair dealing", perhaps, to ask for greater precision, since he tells us in his opening lines that he "has made no effort to give a complete account of the Protozoa" but "rather a study in biology illustrated by the unicellular animals". This is certainly very vague, yet it may possibly be brought to a sharper focus by the fine-adjustment of history—a method of approach to his subject for which the author himself has evidently but little liking

Prof Calkins has now published—including this second edition of the third—no less than four text-books of protozoology · and this is a record No other man has produced so many, single-handed. In 1901—when he was but thirty-two years of age—he gave us "The Protozoa", in 1910, "Protozoology", and in 1926 and 1933 his two versions of "The Biology of the Protozoa". All these works are genetically connected, and together they give us a rough picture of their author's protozoological progress. Their titles alone suggest his steady advance from the definite and concrete into the abstract and obscure.

This can also be shown in other ways. For example, in 1901 Calkins believed whole-heartedly that all Protozoa are "unicellular organisms". Apparently he does so still, but he now finds it necessary to qualify this definition and say that they are organisms "*usually* consisting of a single cell" [italics not in original]. but as this quibble clearly cannot evade the real difficulty, he attempts to safeguard himself by adding that "As organisms the Protozoa are more significant than as cells" (whatever that may mean), and to forestall the obvious rejoinder he roundly alleges that those of us who reject the cell-theory, as applied to the Protozoa, do so merely "through sophistry" Surely the *boot* is on the other foot

In his preface to the original edition (1926), Calkins indicated his general views more fully than he does now He drew a novel distinction between "Protozoa-study" and "Protozoology" as a science, and expressed a hope that his new presentation of the subject might convert the first into the second "The underlying biological principle in this presentation," he wrote, "is the irritability of protoplasm, combined with protoplasmic organization. . . Each such organization, under appropriate stimuli undergoes differentiation through which the derived or visible organization is developed from the fundamental organization Through irritability of protoplasm and reactions to internal stimuli arising through metabolic activities as well as through reactions to external stimuli, the fundamental organization is progressively changed"—and so on, in the same strain But protozoologists—like protozoa—consist of "protoplasm" and are therefore irritable. and some of us, at least, believe that what our science really needs most at present is more "Protozoa-study" and less "Protozoology" (in Calkins's sense) We want more facts, and fewer generalities and obsolete platitudes We have no use for discussions about "the senescence of protoplasm" and similar fossils, because we regard all such antiquities as products of bad bacteriology and worse logic

No one man can now compose an accurate and comprehensive treatise on protozoology in all its manifold ramifications Prof Calkins has been attempting this impossible task—for our instruction and diversion—during more than thirty years, and though some English protozoologists dispute his knowledge and general notions, and few of us share his particular affection for *Paramecium* and *Uroleptus*, we can all admire his courage and feel grateful to him for his persistent presentation of the tenets of his own peculiar sect in America

CLIFFORD DOBELL

Towards a Planned Society

(1) *Education for Industry and Commerce in England.* By A Abbott Pp xiv + 228 (London Oxford University Press, 1933) 5*s* net

(2) *The Anti-Slum Campaign* By Sir E D Simon Pp viii + 206 (London, New York and Toronto Longmans, Green and Co, Ltd, 1933) 2*s* 6*d* net

(3) *Product Money a Sequel to 'Riches and Poverty'* By Sir Leo Chiozza Money Pp xv + 172 (London Methuen and Co, Ltd, 1933) 5*s* net

(4) *Science and Democracy adjusting the Laws of Advancing Mechanization to the Objectives of Civilized Policy* By Frank Trinca Pp v + 202 (Melbourne Brown, Prior and Co, Pty, Ltd, 1933)

THE four volumes under review deal with diverse subjects, but each subject is regarded from essentially the same angle—its place in a planned society and the contribution of science to those many vexed problems with which the advent of power production confronts our age

(1) Technical education in Great Britain has in recent years had no abler expositor than Mr A Abbott, who in this volume gives us not only an admirable yet concise historical review of the development of commercial and technical education during the last century, but also a lucid statement of the present position and an eloquent plea for the framing and carrying out of a definite policy of recruitment and training for the personnel of industry and commerce In his view, two main tasks now confront us First, the conversion of the present secondary school into a more flexible instrument for the common welfare, and secondly, the correlation of our system of technical education with our methods of general education and with the needs of industry and commerce

Both tasks call for a much closer co-operation between industry, commerce and education If the secondary school by modification of its curriculum is to become a more suitable basis for the vocational education of the technical school, it must equally remain at all costs a place of general education, and Mr Abbott does well to direct attention to the dangers of the present examination system in this respect Equally he stresses the bearing of technical education on industrial efficiency and the restoration of our lost prosperity or maintenance of our higher standard of living He makes the trenchant comment that the inefficiency of some industries is due to their failure to utilise the scientific knowledge now available for them, because they do not employ enough men with the necessary wide and thorough scientific training, and he observes that in many branches of industry there is no real hope of applying, on any adequate scale, the new knowledge gained by the various research associations, until the qualifications of the men at the top have been improved The changing nature of industrial skill, which now demands considerable intelligence, a sound general education, a willingness to develop fresh interest and an ability to adapt oneself easily and completely to fresh tasks, enforces the pressing need for a policy of recruitment deliberately conceived by every industry, with this policy should be associated a definite plan of training and promotion in which the exact function to be exercised by the schools has been determined.

With this wide vision and emphasis on a definite policy, the individual aspect is not forgotten. On the contrary, the problems which arise from the decreased vertical mobility of labour are one of the grounds on which a considered policy of recruitment is urged, and the whole book is equally a plea for planned industrial and commercial education, and for an educational system which guarantees to our children expert and sympathetic guidance in choosing a profession and adequate training for its skilled practice The problems of technical education are well and fairly stated, and the book has just claims on the attention of every scientific worker who is concerned with the future of industry and commerce

(2) Sir E D Simon writes as an acknowledged authority on housing, but his book claims the attention of scientific workers as much for its clearly sounded call for national planning in this important field as for its lucid and readable description and analysis of the present housing situation He sees the necessity for what he describes as a 'new type of politician, who

is able to come to a scientific conclusion on matters where his emotions or party interest are involved, and he deplores the weakness of our present party system that, in such matters as housing, each side prefers to urge a distorted version of the facts which suits its own prejudices rather than to ascertain the truth He does more, however, than sound a warning as to the disastrous consequences which flow from a two-party system when each party as it comes into power spends its energy in such fields in reversing the plans of the other

Sir E D. Simon gives us the outlines of a national plan, which includes the provision of an adequate statistical department to prepare the estimates on which a scientific housing problem could be elaborated to meet the real needs of the population. It would include a strong technical department, comprising a research section and taking stock of the needs of the tenant, methods of municipal management, the construction and design of houses and tenements, etc, and a planning department covering planning in all its aspects—the estate, the city, the region and the country as a whole as well as the movements of population and industry The mere enumeration of the essential activities indicates the many gaps which exist in our present knowledge and the inadequacy of our present attack on the problem

The author states a masterly case for a Ministry of Housing or a National Housing Board, which could render services in elaborating new policies and guiding and helping local authorities comparable with those rendered by the Board of Education in its own field It is obvious that he has himself a definite policy conceived on scientific lines, and it is urged with a reasonableness and an emphasis on practical issues which heartily commend it to the scientific worker

(3) Sir Leo Chiozza Money faces the problems with which science confronts society and makes a bold plea for a planned economy His explanation of the arrangement for the exchange of commodities which he describes as "product money" leaves the reader with many unanswered questions in his mind. His explanation is indeed merely a sketchy outline of his proposals, and much of the book is only a restatement of familiar criticisms of the existing credit and currency system. He is much more convincing in his exposition of the inadequacy of present exchange methods to cope with the increasingly rapid expansion of machine production, than in the presentation of his own proposals for the abolition of a circulating medium and the substitution of his product money—"a non-circulating order upon production"

The value of the book lies rather in the outlook, which refuses to accept the present unsatisfactory situation and seeks to find other and adequate methods of solving the problems of production, distribution and exchange

(4) Mr Trinca's essay in the same field is a somewhat disappointing effort. He endeavours to trace in turn the relations of science and industry, the limitations of the machine and the bearing of machine production on employment and finance, and finally the relation of industry to the wider background of economic and social life At the outset he lays a good deal of stress on what he terms the wave-law of inventive progress, but without giving adequate evidence in support of his point, nor does he allow sufficiently for the lessening place of invention in modern industry as a result of the teamwork implicit in industrial research under present-day conditions Mr Trinca handles an interesting theme, another attempt to bring scientific thought to play in every department of life, but this book is marred by so much jargon and careless writing that he is sadly open to the charge of having something to say but not knowing how to say it

R BRIGHTMAN

The Natural Resins

Die Harze Die botanischen und chemischen Grundlagen unserer Kenntnisse uber die Bildung, die Entwicklung und die Zusammensetzung der pflanzlichen Exkrete Bearbeitet von A Tschirch und Erich Stock Dritte umgearbeitete Auflage von A Tschirch *Die Harze und die Harzbehalter* Band 1 Pp xv+418 (Berlin Gebruder Borntraeger, 1933) 47.25 gold marks

THE natural resins continue to increase in economic importance notwithstanding the competition from synthetic materials, and they are the subject of monographs in several languages Prof Tschirch is one of the pioneers in the field and his book has long been a standby for those seeking information This, the third edition, has been completely rewritten with the assistance of E Stock; it covers, as explained in the sub-title, the botanical and chemical basis of the knowledge of the formation, development and composition of the plant excretions. The volume before us contains the general principles of the subject, subsequent volumes being devoted to the individual resins; it is divided into morphological, physical and chemical sections following a lengthy chapter on the formation of the exudates. This first chapter is copiously illustrated both with microscope drawings of cell structure and with photographs of the trees showing the method of collecting; it includes one fine plate in colours illustrating the fluorescence analysis of balsams and resins in the quartz lamp. The thorough and exhaustive nature of these sections which characterise the resins are exemplary.

The chemistry chapter commences with a section some hundred pages in length detailing the historical development of this special inquiry. It starts back in the sixteenth century with recollections of amber, which incidentally gave the name to electricity, and may be traced through the period of qualitative investigation in the eighteenth century and of quantitative study in the early nineteenth from the days of Unverdorben to those of Hlasiwetz. Dry distillation and fusion with alkali were among the processes summoned to help, and protocatechuic acid and phloroglucinol were recognised as important constituents. The application of newer methods to the inquiry largely begins with Tschirch's own work, commencing in 1886. The whole is a story of profound interest to the expert and the value of the section is enhanced by the copious references to the original literature from 1661 onwards; few subjects can have been more thoroughly monographed on the chemical side.

The problem of the resins is far from solved; like other complex polymers of high molecular weight, such as starch and the proteins, they are mixtures—a point emphasised by Tschirch.

The chemical section describes the generalities; the details of each resin will follow in the subsequent volumes. E. F. A.

Short Reviews

A Modern Outline of Evolution. By George Whitehead. Pp. vii+324. (London: John Bale, Sons and Danielsson, Ltd., 1933.) 7*s.* 6*d.* net.

MANY books on organic evolution written by scientific men famous for their researches are suitable to students but not to the public, who do not desire more than passing references to the facts and the general outline of theories. The book before us has no illustrations; it is reasonably cheap and as it nowhere labours, it is comfortable reading. It thus should be a useful guide to those who wish to understand 'the complex manifestations of life'. It is frankly a compilation, the story of the origin of the earth leading up to that of life. Evidences of evolution are next given and then the theories as to how it comes about, suitably ending up with a chapter on vitalistic evolution. Unfortunately there is a certain lack of understanding of the physiology of animals, function and anatomy being two inseparable factors. The chapter on Kropotkin's 'mutual aid' seems a curious and unnecessary interpolation between Darwin and Weissmann, and that on "Mutations and Mendelism" should in our opinion be entirely rewritten.

There can be no clear differentiation in the reader's mind between fluctuations and mutations, and the author's references to the opinions of those who are not researchers in this field are often valueless. The term 'character' or 'characteristic' has a clear meaning, and why it is stated that only about seven such "can be found" in the pea is extraordinary, since recent research suggests that all characters are Mendelian, and more than 400 characters have been determined in *Drosophila*.

Further, no book on evolution can be regarded as complete which does not give some account of recent research on genes, hereditary structural units responsible for every transmissible character. This is now the chief field of research leading up to the understanding of the mechanics of organic evolution, and one which the author need not fear to summarise in his second edition.

Dr. H. G. Bronns Klassen und Ordnungen des Tierreichs. Band 4, Abt. 2, Buch 2: *Acanthocephala.* Bearbeitet von A. Meyer. Lief. 1. Pp. 332. 39.60 gold marks. Lief. 2 (Schlusslieferung). Pp. vi+333–582. 32 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932–1933.)

DR. MEYER gives an interesting historical account of the Acanthocephala from their discovery by Leeuwenhoek (1695) who found two species in the gut of the eel. Koelreuther (1771) and O. F. Muller (1776), who independently recognised that these worms were different from other helminthes, named the first two genera, *Acanthocephalus* and *Echinorhynchus*. Bremser (1811), who is stated to have examined 40,000 individual animals for the presence of Acanthocephala, and Rudolphi, whose published accounts extend over the period 1795–1820, added much to our knowledge of these parasites. Westrumb produced in 1821 the first monograph of the group, which included a description of 90 species and an account of the anatomy and physiology. Leuckart (1862) initiated the studies on the life-history, and various writers, including the author, have developed the systematics of the group.

The historical account is followed by the systematic consideration of twelve families, 58 genera and 258 species and by an admirable description of the external features, biology, anatomy and development. In a short chapter of ten pages the damage caused by these worms in fish and domestic animals and in man is considered. Tables are given showing the hosts, both invertebrate and vertebrate, of Acanthocephala, and the geographical distribution of the genera and species. A key for distinguishing the genera, a detailed bibliography and three indexes (author, systematic and structural) are added The illustrations, 382 in the text and one plate, are well chosen and excellently reproduced, and the work forms an admirably planned and executed monograph

Handbuch der physikalischen und technischen Mechanik Herausgegeben von Prof Dr F Auerbach und Prof Dr W Hort Band 7 *Grenzgebiete der technischen und physikalischen Mechanik* Lief 1. Pp iv+238 Lief 2 Pp vi+239–490. Lief 3 Pp vii+491–814 Lief. 4: *Alphabetisches Sachregister zu Bande 1–7.* Pp xv+815–853 (Leipzig Johann Ambrosius Barth, 1928–1931) 72 gold marks

The appearance of vol 7 completes the publication of this great handbook of physical and technical mechanics (the successor to the famous Winkelmann's "Handbuch der Physik") Publication has proceeded at intervals since 1927, and previous parts have already been briefly reviewed in NATURE The present volume is devoted to border-line branches of mechanics Its articles and their authors are as follows capillarity (Auerbach, 168 pp.), capillary chemistry (Freundlich, 19 pp), disperse systems and the Brownian motion (Fürth, 40 pp), thermodynamics (Auerbach, 48 pp), kinetic theory of gases (Auerbach, 52 pp), statistical mechanics (Furth, 48 pp), fluctuations (Furth, 32 pp), theory of solid states (Braunbek, 38 pp), atomic mechanics (Joos, 33 pp), constitution of matter (Bennewitz, 27 pp.), chemical status and dynamics (Bennewitz, 34 pp), adsorption (Bluh, 42 pp), technical application of adsorption (Berl and Andress, 20 pp), the flotation process (Berl and Schmitt, 20 pp), diffusion without dividing walls (Fürth, 70 pp), osmosis (Furth, 35 pp), technical applications of electro-osmosis (Berl and Andress, 8 pp), solutions (Furth, 46 pp), electro- and magneto-mechanics (Auerbach, 20 pp) An alphabetical subject index to the whole of the seven volumes completes the work

Plant Ecology : for the Student of British Vegetation By Dr. William Leach (Methuen's Monographs on Biological Subjects.) Pp vii+104 (London Methuen and Co , Ltd , 1933) 3*s*. 6*d* net

The increasingly prominent position occupied by habitat factors in modern ecological work is reflected in this book, more than half of which is devoted to a discussion of climatic, physiographic and biotic factors and the methods employed in their practical investigation A particularly large section is devoted to soil problems and, having regard to their all-important ecological influence in Great Britain, this section should prove one of the most acceptable features of the book

The sections dealing with biotic factors and plant succession are well done, the numerous examples illustrating clearly their mode of operation in specific plant communities A chapter is given to the practical side of the subject in which directions are given for mapping vegetation, quadrat and transect observations, and estimating water content, organic matter and hydrogen ion concentration of soils The book concludes with a short account on broad lines of the principal present-day types of British vegetation and of the post-Glacial changes which have occurred as revealed by peat investigations

Diseases of the Heart described for Practitioners and Students By Sir Thomas Lewis (Department of Clinical Research, University College Hospital, London) Pp xx+297 (London . Macmillan and Co , Ltd , 1933) 12*s* 6*d* net

The name and reputation of the author of this book are sufficient guarantee of the accuracy of its contents and the wisdom of its teaching , but what makes it particularly attractive is its unusual arrangement, which is that of disorders of cardiac function, rather than of diseases of the heart The distinction is no small one , a patient's heart concerns him only in its degree of competence to carry out its work , that this aspect should be the main concern of the physician is the basis of Sir Thomas Lewis's teaching, and one of the best features of his book is its departure from the traditional arrangement of "diseases of the pericardium, of the muscle, of the valves", preceded by the stock "anatomy and physiology" If any practitioner tends to forget that his work is to treat patients, not diseases, this book, and in particular a certain half-dozen paragraphs in the last chapter, will provide the reminder

Epidemiology, Historical and Experimental the Herter Lectures for 1931 By Major Greenwood Pp x+80 (Baltimore, Md The Johns Hopkins Press , London . Oxford University Press, 1932.) 9*s*. net

In this little book are reproduced the twentieth series of the Herter lectures, delivered in 1931 by Prof Major Greenwood The first lecture is historical, the second describes a biological experimental study of epidemics, and the third considers the subject of immunity The biostatistical method of investigating disease in experimental communities leads the author to some interesting conclusions relating to the influence of the introduction of non-immune members into a herd , and although it does not yet contribute any suggestion to the problem of controlling epidemics, its more extended application may indicate the means by which real progress can be made.

The New Hydrogen*

By THE RIGHT HON LORD RUTHERFORD, O M, F R S

FOR more than a century scientific men believed with confidence that pure water was a well-defined chemical substance, H_2O, of molecular weight 18. This belief was shown by the fact that the unit of mass, the kilogram, consisting of a cylinder of platinum-iridium, was initially chosen to be of the same mass as 1,000 cubic centimetres of water at the temperature of maximum density. Subsequent measurements showed that this was slightly in error, so that the unit of mass was defined in terms of the metal standard. It was only about four years ago that this confidence was slightly disturbed as a result of the study of the isotopic constitution of oxygen. Instead of being a simple element of mass 16, oxygen was found to contain in small quantity isotopes of masses 17 and 18. It was clear from this that pure water must contain some molecules of weight 19 and 20 as well as the normal 18. Since, however, it seemed very unlikely that the proportion of the isotopes could be sensibly changed in the processes of preparation of pure water, this result, while of much theoretical interest, did not appear to have any practical importance.

As a result of investigations during the last two years, there has been a revolutionary change in our ideas of the constancy of the constitution of water. This has resulted from the discovery that a hydrogen isotope of twice the normal mass is always present in preparations of ordinary hydrogen. While this isotope of mass 2 exists only in small proportion—only about 1 in 6,000 of the main isotope of mass 1—yet, on account of the marked difference in mass of the two components, the relative concentration of the two isotopes can be varied in a marked way by various physical and chemical processes. This is seen by the fact that we are now able to obtain preparations of water in which the isotope of hydrogen of mass 1 is completely replaced by the isotope of mass 2. The density of the heavy water is about ten per cent greater than ordinary water; while its freezing point is 3·8° C, and its boiling point 1·42° C, higher. Though in outward appearance this heavy water resembles ordinary water, yet in general its physical and chemical properties show marked differences. Not only does the vapour pressure vary markedly from the normal, but also the latent heat is considerably higher. Both the surface tension and specific inductive capacity are lower while the viscosity is much greater.

It is of interest to indicate briefly the almost romantic history of this rapid advance in knowledge, and to note that there are certain points of analogy between the discovery of heavy hydrogen and the discovery of argon in the atmosphere by the late Lord Rayleigh. In both cases the clue to the discovery depended on the recognition of the importance of small differences observed in accurate measurements of density.

When the relative abundance of the isotopes of oxygen was first measured, Birge and Mendel showed that there was a slight discrepancy—only about 1 in 5,000—between the ratio of the masses of the atoms of hydrogen and oxygen measured by Aston by the method of positive rays and the ratio deduced by direct chemical methods. They concluded that this small difference was greater than the probable experimental error in the measurements and in explanation suggested that hydrogen might contain in small quantity—about 1 in 4,000—an isotope of mass 2. Let us consider for a moment how the presence of such an isotope could be demonstrated by direct experiment. Both the H^1 and H^2 isotopes would have the same nuclear charge of 1, and have one external electron, and would thus be expected to give the same type of optical spectrum under the influence of the electric discharge. It is to be remembered, however, that the electron, the movements of which when disturbed give rise to its characteristic radiations, is coupled to the nucleus, and that the rates of vibration, although mainly governed by the nuclear charge, are slightly affected by the mass of the nucleus itself. On account of the greater mass of the H^2-isotope, it can readily be calculated that the Balmer lines in the spectrum of heavy hydrogen should appear slightly displaced towards the red. In the case of the α line, the displacement amounts to 1·78 angstrom units. When an electric discharge is passed through ordinary hydrogen, weak satellites should thus appear on the side towards the red. The presence of such weak satellites in the right position was first detected in experiments made for the purpose by Urey, Brickwedde and Murphy. The intensity of the satellite compared with the strong H_α line was difficult to measure with certainty but was found to be of the order of 1 to 5,000.

Experiments were then made to enrich the H^2 isotope by fractional distillation of liquid hydrogen, and with some success. Another important observation was made by Urey and Washbourn, who found that the water in old electrolytic cells contained a larger proportion of heavy hydrogen than the normal. The concentration of H^2 was found to be rapidly enriched by continued electrolysis. This gave the key to a successful method of obtaining heavy hydrogen in quantity. The processes involved were carefully investigated by Lewis and Macdonald, and the electrolysis of water was carried out on a comparatively large scale. Nickel electrodes were used, and sodium hydroxide as an electrolyte. In general, it was found that the escape of H^1 during electrolysis was five to six times faster than that of H^2 relative to their concentrations in the solution. There was in consequence a steady accumulation of the heavy isotope in the water in the process until nearly pure heavy water was obtained Assuming that the initial concentration of H^2 in the water was 1 in 6,000, about 1 c c. of pure heavy water should be obtained by electrolysis of 6 litres of water

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* Discourse delivered at the Royal Institution on Friday, March 23.

Lewis succeeded in preparing many cubic centimetres of heavy water in which ordinary hydrogen was present in very small quantity He and his collaborators investigated the main physical and chemical differences between heavy water and ordinary water, to some of which I have already referred Our congratulations are due to our American colleagues for the masterly way they have opened up and developed so rapidly this new field of knowledge, which it is certain will prove of great scientific and practical importance in many directions in the near future Prof G N Lewis, of the University of California, who was the first to prepare nearly pure heavy water, generously presented samples of this water to a number of investigators, not only in his own country but also in Europe, in order to give them an early opportunity of testing its properties I am personally much indebted to Prof Lewis for a sample of this heavy water with which we were able to make a number of experiments on the transformation of matter to which I shall refer later

We are all aware of the important part that hydrogen plays in many chemical compounds and particularly in organic molecules When reasonable supplies of heavy water are available to the experimentor, there will no doubt be great activity in preparing and studying many compounds in which H^1 in the molecule is wholly or partly replaced by H^2 Already a few investigations have been carried out, for example, with ammonia and with hydrogen iodide, in which H^1 is replaced by the heavy isotope It has been found that in mixtures of light and heavy hydrogen gas, the atoms interchange on a nickel surface at a temperature of about 600° C and the conditions of equilibrium and heat evolution have been investigated. During the next few years we may expect an intensive study to be made of the change of properties of compounds in which heavy hydrogen is used It will be of particular interest to examine the changes in the rates of reaction at different temperatures when heavy hydrogen is substituted for ordinary hydrogen

The discovery of the new water will be of great importance in another direction, namely, its effect on the processes occurring in animal and plant life There has not yet been sufficient time to make more than a few preliminary experiments in this field, and then only on a small scale. Lewis finds that seeds of a certain tobacco plant did not germinate in pure heavy water but did so when the concentration of heavy hydrogen was about one half In experiments by other observers, well-defined physiological effects have been obtained for quite small concentrations of heavy hydrogen in water. Further observations in this highly important field of inquiry will be awaited with much interest

It is widely recognised that the new hydrogen will prove of so much general importance to chemistry and physics that it is desirable to give it a definite name and symbol Prof Urey, its discoverer, has suggested that the isotope of mass 1 should be called 'protium' and the isotope of mass 2 'deuterium', while the nucleus of heavy hydrogen, which has already been found very efficient as a projectile in transforming matter, should be called 'deuteron' or 'deuton' The question of a suitable nomenclature is one of general importance to scientific men and deserves careful consideration The name 'diplogen' (διπλους, double) for H^2 and 'diplon' for the nucleus seemed to find some favour in England as an alternative The symbol D for the heavy isotope seems appropriate

While diplogen (or deuterium) may be separated in quantity from heavy water in nearly a pure state, it is of interest to refer to another method of separation employed by Hertz By utilising a special diffusion method devised by him, he has been able to separate from ordinary hydrogen gas about 1 c c of diplogen in such purity that the Balmer lines of hydrogen were not visible in its spectrum With such pure material, it should be possible to study in detail the complicated band spectrum of diplogen and compare it with that of hydrogen

We have not so far considered the question of the nuclear structure of diplogen and its relation, if any, to that of ordinary hydrogen We first of all require to know its mass with accuracy, this has been measured by Bainbridge by using a modification of the positive ray method, who found that the mass of the atom is 2 0136 while the mass of the hydrogen atom is 1·0078 in terms of the mass of the main isotope of oxygen taken as 16 This mass is slightly less than the combined mass of two H atoms Sufficient evidence is not yet available to decide whether the D nucleus is simple or composite, and there are a number of possible combinations to consider between the four units, the electron, positron, neutron and proton If we assume, as seems not unlikely, that the D nucleus consists of a close combination of a proton with a neutron, it can be shown from the masses concerned that its binding energy should be somewhat less than 1 million volts if we take the value 1 0067 for the mass of the neutron as estimated by Chadwick If this be the case, we should expect the diplon to be broken up occasionally into a proton and neutron as a consequence of a close collision with a fast α-particle. Experiments to test this have so far yielded negative results If this dissociation occurs at all, the probability of such an event must be very small Lawrence, from a study of the bombardment of elements by diplons, suggests that the diplon may break up into a proton and neutron in the strong electric field close to the bombarded nucleus, but the interpretation of his results is not yet certain At the moment, therefore, the experimental evidence is insufficient to give a definite decision with regard to the structure of the diplon

By comparing the scattering of α-particles when passing through diplogen and hydrogen gas, Mr. Kempton and I have found that as the result of a head-on collision with an α-particle, the recoiling diplon travels about eight per cent farther than the proton in a corresponding collision Such a result is in agreement with calculation It also seems clear that the field of force round the diplon must be very similar to that of the proton, although it may be expected that some differences would be shown for very fast α-particles if the diplon is composite as we have supposed

TRANSMUTATION OF ELEMENTS

The discovery of heavy hydrogen has provided us with a new form of projectile which has proved markedly efficient in disintegrating a number of light elements in novel ways It was a very fortunate coincidence that, when Prof Lewis had prepared some concentrated diplogen, his colleague in the same University, Prof Lawrence, had available his ingenious apparatus for producing high-speed protons and other particles with an energy as high as two million volts When diplogen was substituted for hydrogen, the diplon (D^+) was found to be about ten times as efficient in promoting some transformations in lithium as H^+ of equal energy It will be remembered that Cockcroft and Walton found two years ago that lithium, when bombarded with fast protons, was transformed, with the emission of swift α-particles It seems clear that in this case the lithium isotope of mass 7 is involved A proton is captured by the nucleus and the resulting nucleus breaks up into two α-particles, ejected in nearly opposite directions, according to the relation

$$\mathrm{Li}^7_3 + \mathrm{H}^1_1 \rightarrow \mathrm{He}^4_2 + \mathrm{He}^4_2$$

The emission of other particles of short range has also been observed but the exact nature of the transformation which gives rise to them is not yet clear

When lithium is bombarded with diplons instead of protons, different types of transformation occur In one case it seems that the lithium isotope of mass 6, after capturing a diplon, breaks up into two α-particles according to the equation

$$\mathrm{Li}^6_3 + \mathrm{D}^2_1 \rightarrow \mathrm{He}^4_2 + \mathrm{He}^4_2$$

In this case also, as has been shown beautifully by the expansion photographs obtained by Dee and Walton, the two α-particles are shot out in opposite directions and with a speed greater than the swiftest α-particle from radioactive substances

Still another interesting type of complex transformation occurs in this element. Oliphant and Rutherford observed that lithium when bombarded by diplons gave, in addition to the group of fast α-particles first observed by Lawrence, a distribution of α-particles of all ranges from 7·8 cm to 1 cm in air. It is believed in this case that the isotope of mass 7 captures a diplon and then breaks up into two α-particles and a neutron according to the relation

$$\mathrm{Li}^7_3 + \mathrm{D}^2_1 \rightarrow \mathrm{He}^4_2 + \mathrm{He}^4_2 + n^1_0$$

This transformation is in close accord with the conservation of energy when the change of mass and the energies of the expelled particles are taken into account The emission of neutrons from lithium has been observed by Lauritsen and also in our experiments In addition, Lawrence has shown that a number of other light elements give rise under bombardment to groups of fast protons and in many cases also to α-particles and neutrons While the interpretation of the experimental results is as yet only clear in a few cases, there can be no doubt that the use of heavy hydrogen will prove invaluable for extending our knowledge of transformations and thus in helping to throw light on the structure of atomic nuclei

The importance of this new projectile in studying transformations is well illustrated by some recent experiments made in Cambridge with Oliphant and Harteck When diplons were used to bombard compounds like ammonium chloride, NH_4Cl, and ammonium sulphate, $(NH_4)_2SO_4$, in which ordinary hydrogen was in part displaced by diplogen, enormous numbers of fast protons were found to be emitted, even for an accelerating voltage of 100,000 volts In fact the number of expelled particles is far greater than that observed in any other type of transformation at this voltage The main groups of expelled protons had a range in air of 14 cm, corresponding to an energy of 3 million volts In addition to this group, another strong group of singly charged particles were observed of range in air only 1 6 cm Both of these groups contain equal numbers of particles

In order to account for these observations, it seems likely that, as the result of a close collision, the diplon occasionally unites with the struck diplon to form a helium nucleus of mass 4 and charge 2, but containing a large excess of energy over the normal helium nucleus The new nucleus is in consequence explosive and breaks up into two parts, one a fast proton and the other a new isotope of hydrogen H^3_1 of mass 3 If this be the case, the proton and H^3 nucleus should fly apart in opposite directions It can be simply calculated that the range of the recoiling H^3 nucleus under these conditions should be 1·7 cm—a range agreeing closely with that actually observed The changes occurring are illustrated by the equation

$$\mathrm{D}^2_1 + \mathrm{D}^2_1 \rightarrow \mathrm{He}^4_2 \rightarrow \mathrm{H}^3_1 + \mathrm{H}^1_1$$

From the known masses of D and H^1 and the energy of the observed motion of the H^1 and H^3 particles, it can be deduced that the mass of this new hydrogen isotope is 3 0151

In these experiments, large numbers of neutrons are also emitted It appears probable that these arise from another mode of disintegration of the newly formed helium nucleus according to the relation

$$D_1^2 + D_1^2 \rightarrow He_2^4 \rightarrow He_2^3 + \text{neutron},$$

an isotope of helium of mass 3 and a neutron being expelled in opposite directions. There is strong evidence that such an isotope of helium also appears when the lithium atom of mass 6 is bombarded by protons, and from this transformation it appears that the mass of this isotope is 3 0165 It is quite likely that the helium nucleus of mass 3 formed in this way is unstable and may possibly break up into H_1^3 and a positive electron While the conclusions outlined above are to some extent provisional and require confirmation by other methods, there can be no doubt that the effects which follow the collisions of a swift diplon with another are of much importance and interest in throwing light on possible modes of formation of some of the lighter nuclei

It is of interest to speculate why the heavy isotope of hydrogen appears in many cases far more effective, for equal energies, in producing transformations than the lighter isotope On the general theory of transformation proposed some years ago by Gamow, it is to be anticipated that, for equal energies of motion, the diplon on account of its heavier mass would have a smaller chance of entering a nucleus than the swifter proton It may be, however, that normally only a small fraction of the protons which actually enter a nucleus are able to cause a veritable transformation, the others escaping unchanged from the nucleus On this view, the greater efficiency of the diplon in causing transformation may be due to the fact that a much larger fraction of those which enter the nucleus are retained by it, leading to a violent disintegration of its structure It may be too that the diplon on entering a nucleus breaks up into its component parts The appearance of the proton as well as the neutron in some of the transformations may be connected with the composite structure of the diplon.

Deep Water Circulation of the Atlantic

DR G. WÜST, oceanographer in the German research vessel *Meteor*, has recently published the first part of vol 6 of the reports of the German Atlantic expedition* The report is not only a description of the *Meteor*'s results, but is also a history of the investigation of the Atlantic deep waters, and gives a critical summary of all the observations that have been made from those of H M.S. *Challenger* (1873–1876) to those of the R R.S. *Discovery II* (1929–1931) At the end of the report is a complete list of the observations used

Dr Wüst has made extensive use of the principle that if the water in a deep current sinks to a lower level, its temperature will increase as the water becomes adiabatically compressed, and conversely, that if the deep current rises, the water in it is cooled owing to adiabatic expansion Any attempt to follow the path of a deep current in a vertical section showing temperature distribution is made much more difficult by these changes It was first suggested by Prof Helland-Hansen that the difficulty should be removed by using vertical sections showing the distribution of potential temperature—the temperature to which the water would be cooled if it were raised adiabatically to the surface. This report is a striking tribute to the advantage of this method.

In the report there are charts showing the actual temperature, the potential temperature, and the salinity of the bottom water (at depths greater than 4,000 metres) over the whole of the Atlantic Ocean There are also vertical sections which show the distribution of potential temperature, and salinity, along the east and west Atlantic basins, on either side of the mid-Atlantic ridge With their help, Wust shows that the flow of antarctic and arctic bottom waters is much more asymmetrical than it was thought to be Antarctic bottom water flows northwards along the sea bottom, mixing with the warmer North Atlantic deep water which is flowing southwards above it The last traces of the antarctic water reach as far as 34° N in the east Atlantic basin and to 40° N in the western basin. The influence of bottom water of arctic origin can only be detected north of these latitudes as a very weak current

From the relations between potential temperature and salinity, Wüst has been able to find the percentage of antarctic water at the bottom in both basins in all latitudes. These percentages are shown by two curves The decrease of the antarctic water along the western basin is almost regular, it is hastened in about 5° S. where the Para rise obstructs the bottom current In the eastern basin the northward flow is stopped at the Walfish ridge, which extends transversely from the African coast to the mid-Atlantic ridge. The antarctic bottom water north of this ridge enters the basin from the west through the Romanche channel, a break in the mid-Atlantic ridge near the equator. The bottom water flowing through this channel spreads southwards to the Walfish ridge and northwards to 34° N By means of a chart showing the distribution of potential temperature at the bottom of the Scotia Sea, based principally on the observations made by the ships of the "Discovery" Committee, Wüst has been able to show that antarctic bottom water also flows westwards into the Pacific Ocean

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* *Schichtung und Zirkulation des Atlantischen Ozeans* Lief 1 *Das Bodenwasser und die Gliederung der Atlantischen Tiefsee.* Von Georg Wüst (Wissenschaftliche Ergebnisse der Deutschen Atlantischen Expedition auf den Forschungs- und Vermessungsschiff *Meteor* 1925–1927, herausgegeben im Auftrage der Notgemeinschaft der Deutschen Wissenschaft von A. Defant, Band 6, Teil 1) Pp 107+8 Beilagen (Berlin und Leipzig. Walter de Gruyter und Co., 1933.) 20 gold marks.

It is interesting to note that the increase in temperature of the bottom water in the direction of flow can be accounted for solely by mixing with the North Atlantic deep water No increase in temperature due to heat conducted through the earth's crust can be detected, and earlier attempts to measure the speed of the bottom current based on the assumption that the increasing temperature is the result of such conduction have been proved worthless

The vertical distribution of potential temperature far south has changed Wust s views on the origin of antarctic bottom water He now believes that the coldest water is that which is cooled right through on the antarctic shelf in winter and sinks down the continental slope This was the view held by Drygalski and Brennecke but it could not be proved, because all the observations made in the open sea show that the bottom water is always covered with a layer of warm deep water through which the bottom water cannot be seen to sink This warm layer is only absent from channels or basins adjacent to the antarctic continent which are cut off from the open sea by well defined ridges rising above the level of the layer In such basins there may be almost complete mixing from the surface to the bottom

Wüst, in attempting to find a vertical series of observations which showed the cold water from the shelf sinking down the continental slope has used a series (Deutschland St 125) in such an enclosed basin, from which the water cannot sink because of a ridge His failure to recognise this fact and the omission of the ridge makes the diagram on p 45 misleading He distinguishes a slightly warmer bottom water which he calls antarctic deep water , he believes it to be formed by the effect of strong cooling and formation of ice in autumn and winter on the surface water in a convergence region situated near the edge of the pack ice between 60° and 66° S In this theory, Wust appears to be making a determined attempt to bring the views which he and Nansen have expressed on the formation of antarctic and arctic bottom water into accord with the known data regarding the circulation of the Weddell Sea There is very little reason for believing that a convergence region exists, the deep water is probably bottom water which upwells in the middle of the cyclonic movement

Wust has shown that there is very close agreement between the distribution of antarctic bottom water and the distribution of sediments poor in calcium (particularly the red clay) North of 34°–36° N where the streams of antarctic water die away, the bottom deposits are no longer poor in calcium The antarctic water dissolves calcium and over each of these poor deposits it has been found to be enriched The report shows that in such places the density of the water calculated from the usual chlorinity ratio is too low By means of sections giving the distribution of potential density, it is shown that the density of antarctic bottom water calculated from the usual ratio is less than that of the North Atlantic deep water This is because there is a chlorine deficit in the bottom water, or as there is some reason to believe, a chlorine excess in the North Atlantic deep water Wust points out that there is a pressing need of accurate physical and chemical determination of these small density differences, and of new tables and methods for the practical determination of density and salinity and the correction of densities calculated from chlorine contents G E R D

Obituary

DR F A BATHER, F R S

FRANCIS ARTHUR BATHER, born in 1863 was the eldest son of the late Mr A H Bather From Winchester he gained a scholarship at New College, Oxford, where he graduated in 1886, taking first class honours in natural science In 1887 he entered the Department of Geology in the British Museum (Natural History), where his care was chiefly the fossil echinoderms, and notably the crinoids In 1892 he gained the Rolleston prize of the Universities of Oxford and Cambridge for research in biology His first scientific publication of importance was on the Crinoidea of Gotland, in 1893 He was married at Stockholm in 1896, and in 1897 he was awarded the Wollaston fund of the Geological Society On the retirement of Dr Henry Woodward in 1902, Dr Bather was appointed deputy-keeper, a position which he held until 1924, when he assumed the keepership vacated by Dr (now Sir) Arthur Smith Woodward He was elected fellow of the Royal Society in 1909, and in 1911 was awarded the Lyell medal of the Geological Society and served as president of that body in 1926–28 He was also a member of several foreign scientific societies Retiring from the Museum in 1928, he still visited the Department of Geology to pursue his researches on crinoids which had been seriously interrupted by his administrative duties as deputy keeper and keeper Though failing in health during the past year he was active until the last, and when after two days' illness he passed away on March 20, the sad news came as a shock to his many friends

Such, in bare outline, was the professional career of one whose many sidedness was continually a surprise to those who knew him and, of course, such a bald enumeration of facts can give no distinctive picture of the man, even as a professional palæontologist Nor is it always easy, in considering Dr Bather s many activities, to draw the line between his professional and other interests

The need of clear thinking in scientific researches, and of lucid exposition in scientific description, developed in him a mastery of style in writing and diction which harmonised with his appreciation of literature, and especially with his love of Shakespeare. That, in turn, found a further outlet in his dramatic talent—the practical expression of literature—just as museum 'curating' gave scope to the practical side of his scientific interest He always insisted that all who could do so should draw the illustrations for their own scientific papers, and it is not, therefore, surprising to learn that he appreciated art, and to some extent practised both drawing and painting So his many outside activities could be seen to spring from qualities which, used and developed in his professional work, demonstrated the essential harmony of his nature

More closely bound to his strictly professional work were what were perhaps the two greatest preoccupations of Dr Bather's unofficial life—museum technique and scientific journalism His chief official duties were 'curating' and identifying, and, as a wide knowledge of museum technique is obviously desirable for making a perfect curator, so research is necessary for identifying material, and the critical faculty which research engenders, easily developed in Dr Bather into a flair for reviewing and other journalistic activities It was to be expected, then, that when the Museums Association was founded, Dr Bather from the first was one of its most active supporters and inspirers and, through the *Museums Journal*, its most eloquent mouth-piece He presided at the Aberdeen conference in 1903, and his enthusiasm for the Association continued until his death His journalistic activities were widely spread Early in life he edited the periodical *Natural Science*, and for many years the *Museums Journal* Articles, notices and letters were ever flowing from his pen; but perhaps his most appreciated efforts were the delightful reviews which he wrote for the *Times Literary Supplement*

But all Dr Bather's outside interests, his zeal for museum technique, and his critical and literary talent, were subordinated to his professional work Were the foreign museums ahead of the British Museum in this respect? Corresponding improvements must be procured for the Department of Geology. Did that standard obtain in any journal or scientific publication? The Department's publications must set the standard for all outside bodies So keen was he upon the adoption of this or that improvement, even in the little things of curatorial practice, that he appeared more pleased with the appreciation shown him by the application of one of them, than by a favourable reception of his scientific papers. I know that he sometimes felt that his labours for improved curating were not fully appreciated; whereas an enumeration of the improvements, great and small, in curatorial practice introduced by him should have effectively silenced that misgiving. He has been considered to have had too great a consideration for minutiæ. Indeed, his mind marched with his who wrote —

> "Thus, if this Age but as a comma show
> 'Twixt weightier clauses of large-worded years,
> My calmer soul scorns not the mark: I know
> This crooked point Time's complex sentence clears"

Dr Bather insisted on the comma because he appreciated its relation to the whole

If his colleagues have not always appreciated as fully as Dr Bather would have liked all his curatorial 'gadgets', there is no fear of their ever under-rating the brilliance of his scientific work His clear exposition, clean style, and description couched in the most direct language, as well as his orderly presentation and accuracy of detail, are nowhere better shown than in what he himself considered his master-work—"Caradocian Cystidea from Girvan" This and his other scientific treatises are the standards to which his colleagues aspire in their own publications, and in which they recognise him as indeed a master

It was Dr Bather's expressed intention, when at last relieved of administrative duties, to resume his interrupted researches upon fossil echinoderms, and particularly crinoids It was the hope of some, at least, of his friends, that his last years would produce some masterpiece of synthetic thought dealing with the evolutionary aspects of palæontology But, when Dr Bather retired, he no longer possessed the energy needed to disengage himself from the multifarious interests which entangled him, and prevented him from resuming his studies uninterruptedly Thus we consider his life-work incomplete The larger vision may see in his widely-flung helpfulness a life better proportioned and more complete than we suppose

Dr Bather suffered fools kindly, and with humour, and if at times, like Wisdom, he led them by crooked ways and tormented them with his discipline, his patience with stupidity was remarkable, and no one who has been through his 'mill' will deny that it has been worth while to have been taught by Dr Bather how to write a paper or arrange a collection, or will fail in gratitude to him His intellectual honesty, and devotion to duty, tempered with a most kind heart, and lightened by a charitable sense of humour, indicated the quiet flow of his genius beneath a restless exterior W D LANG.

PROF. S F OLDENBURG

WE regret to record the death on February 28 at the age of seventy years of Prof. Sergius Fedorovitch Oldenburg, the well-known Russian orientalist and former permanent secretary of the Russian Academy of Sciences

Prof Oldenburg was born at Byanking in Siberia and was educated at Warsaw and the University of St. Petersburg, where he specialised in oriental languages and more particularly the Indian dialects. After graduation he was for a time engaged in research work at Cambridge His first book on "Buddhist Legends" appeared in St Petersburg in 1894 In 1895 he was appointed to the chair of Indian languages and literature in the University of St. Petersburg, which he held for thirty years His election to the Academy of Sciences in 1903 was followed in the next year by his appointment as permanent secretary of the Academy and soon after he was made director of its Asiatic Museum

At this time Germany, France and Great Britain, through Grünwedel and von Le Coq, Pelliot and Stein respectively, were engaging in a campaign of intensive archæological exploration in Chinese Turkestan Attention had been attracted to this territory by the Russian expedition under Klements in 1898 and by Sven Hedin's explorations, but the full extent of the opportunities for archæological research had been revealed only by Stein's discoveries Russia's desire to participate in this important work in the field was met by the organisation under Oldenburg's direction of an expedition of exploration to the oasis of Kucha under the leadership of Berezowski (1906–7) Later, another expedition was sent out by the Academy under Oldenburg himself, which explored Karashahr and Turfan and brought back a rich store of manuscripts, paintings and sculpture from the caves of Tung-hwang discovered by Sir Aurel Stein The results of the expedition were published in Oldenburg's valuable book, "The Russian Expedition to Turkestan" (1914 in Russian).

After the revolution of 1917, Oldenburg retained his chair and his secretaryship of the Academy for twelve years. His experience in the organisation of research both at home and in the field was of material assistance to the Soviet Government in carrying out its desire to re-establish archæological and ethnological exploration In 1929, however, he was dismissed from his posts for political reasons by the Government, but he was so far readmitted to favour that the Academy and other scientific bodies were permitted to express recognition of the celebration of his seventieth birthday

WE regret to announce the following deaths

Col Arthur Lynch, author of several original books on psychology, philosophy and relativity, on March 25, aged seventy-two years

Prof C Matignon, professor of inorganic chemistry in the Collège de France, president of the Société Chimique de France, on March 18, aged sixty-six years

Sir Thomas Muir, CMG, FRS, formerly superintendent-general of education in Cape Colony, author of works on the history of determinants, on March 21, aged eighty-nine years

Prince Sixtus of Bourbon-Parma, whose expeditions to Central Africa produced valuable scientific results, on March 14, aged forty-seven years.

Dr E W Washburn, chief chemist in the United States Bureau of Standards, on February 5, aged fifty-two years

News and Views

Petroleum in Great Britain

OCCURRENCE of petroleum in Britain is once again in the limelight, this time focused by what, from a public point of view, seems to be sudden and dramatic action on the part of the Government On March 22, the President of the Board of Trade announced in the House of Commons that the whole question of oil exploration has recently been reviewed following renewed activities in this direction It is intended to introduce legislation forthwith to remove certain difficulties existent under the Petroleum (Production) Act 1918, and to secure orderly development of any oil which may be discovered. The most far-reaching and drastic proposal is that ownership of all petroleum at present unknown shall be vested in the State A licence to explore for oil must be obtained from the Board of Trade, payment being made to the Exchequer on any oil produced. The bill was introduced in the House of Lords on March 22. In addition to the provisos mentioned above, the bill makes possible compulsory acquisition of rights to enter on land; further, that in considering any application made to the Railway and Canal Commission under that Act, the Commission shall have regard to the effect on the amenities of the locality. Compensation in respect of granting prospecting rights is to be made subject to additional allowance of not less than ten per cent on account of compulsory acquisition

OTHER clauses of the bill deal with the Board of Trade receipts and expenses in connexion with licences, payments to the Exchequer, the manner in which and persons by whom applications may be made, fees, size and shape of chosen areas, right to inspect all plans, etc., the Board throughout exercising its powers through the Secretary for Mines The opportunity was obviously one too good to be missed by certain more sensational sections of the Press, which translated what is essentially a sober, political measure into actual discovery of oilfields, one paper even going so far as to give a map depicting the 'track of the oil belt' from the Humber to Cardigan Bay! In a long experience we doubt whether British geology has ever received such flagrant affront. Aside from technicalities, it is common knowledge that the existing licences held under the Act of 1918 are in respect of Hardstoft, Derbyshire (1923), Heathfield, Sussex (1930) and Three Bridges, Sussex (1931), trial borings also being made at Hythe, Kent, in 1929. In no case have these activities attained commercial status. The drilling epic of 1918–22, a War-time measure, though forgotten by the public, is still fresh in the minds of oil technologists in Great Britain, and no Government bill, reports of foreign enterprise, secret explorations in Derbyshire or elsewhere, animates us from resignation to facts which one-time emergency and progressive geological knowledge have taught.

OIL pools of commercial magnitude (*pace* natural gas, shale oil and allied indications and potentialities) cannot reasonably be anticipated in any known area in Great Britain Many years of official geological survey—a centenary in 1935 in point of fact—together with much independent work, leave few spots unknown, if not in detail, at least in sufficient outline to preclude even faint hope The Government measure is discreetly, if not satirically, worded · it refers to oil which *might* be discovered or *may* exist, it excludes Northern Ireland from the Bill, presumably on political grounds, in this, as with the rest of Great Britain, it has the silent approbation of British geology, though it is in the public interest that that silence should be officially broken if the present bill is in any way interpreted as supporting authoritative views that oil does indeed exist in Great Britain and only awaits public money for its development.

Royal Botanic Gardens, Regent's Park

WHEN the lease of the Royal Botanic Society, Regent's Park, terminated in 1931, the grounds were thrown open to the public, but arrangements were made with the Office of Works for continuing the investigations in genetics which had been carried on there since the War This arrangement has now been placed on a permanent basis, a portion of the original Gardens, including a quadrangle of buildings and the adjacent grounds, having been set aside for this work on rental from the Office of Works Through the action of Prof R. Ruggles Gates, the Courtauld research fund of £5,000 has been obtained as an endowment for this work, which is an important extension of the research facilities of the Department of Botany, King's College. The facilities include two greenhouses with boilers for heating, a potting shed, tool house, cold frames and a laboratory of four rooms. The latter is being fitted up for the examination of genetical material and the collection and treatment of cytological material from plants grown in the Gardens, as well as for photographic work The Empire Cotton Growing Corporation is also making a grant for three years in aid of further researches on cotton and its relatives. Various other temperate and tropical economic plants are being investigated. The fundamental researches in cytogenetics, with which the name of Prof. Gates has been connected for many years, have now been extended to include a study of the native species of *Œnothera* in eastern Canada The phenomena of distribution, relationships and hybridisation of the native species and varieties (many of them undescribed) found in this area constitute a genetic survey which throws light on many phases of the complicated evolutionary problems in this genus.

Sir Charles Parsons Memorial

THE Sir Charles Parsons Memorial Executive Committee, composed of the presidents of thirteen scientific and technical societies, with the Engineer-in-Chief of the Fleet, and presided over by Sir Frederick Gowland Hopkins, has just issued a statement of its aims and an appeal for subscriptions. Observing that the name of Parsons will ever be remembered with those of Newcomen, Watt, Trevithick and Stephenson, and that his fame was due not only to his work in marine and electrical engineering, but also to his investigations in various branches of physics, the statement says that it has been decided that the memorial shall take several forms. It is proposed, first, to place a memorial to him in Westminster Abbey; secondly, to found an annual lecture to be given by a distinguished man of any nationality, who will be chosen in turn by the various scientific and technical societies; and thirdly, it is proposed to arrange with the governors of London House that the library in that House shall be called the "Parsons Research Library". A bronze medal will be established in connexion with the annual lecture and a bust of Sir Charles Parsons will be placed in the library London House was founded in 1931 as a hall of residence for Dominion and Colonial men students of white parentage, from the Empire overseas The property, now under development, covers an area of about 1½ acres in the Bloomsbury district close to the University of London, and the proposed library will contain scientific and technical works To carry out the whole scheme, it has been estimated that a sum of at least £12,000 is required Copies of the appeal are being sent to members of the societies concerned, and the Executive Committee suggests that in general the maximum subscription should be two guineas. Donations should be sent to the Royal Society, Burlington House, W 1, and cheques made payable to the "Sir Charles Parsons Memorial Fund"

The New Hydrogen

IN the course of Lord Rutherford's Friday evening discourse on March 23 at the Royal Institution (see p. 481), experiments were shown to illustrate the differences in freezing point and in vapour pressure between ordinary and heavy water, and the differences in heat conductivity between ordinary and heavy hydrogen For the first time, experiments were made to show the artificial transformation of lithium by protons and diplons of energy corresponding to about 100,000 volts The enormous emission of fast protons when ammonium sulphate containing heavy hydrogen was bombarded by diplons was clearly shown by counting methods. The transformation apparatus was designed and operated by Dr. Oliphant, while Messrs. Watson and Sons (Electro-Medical) Ltd loaned an installation to provide a steady potential of 100,000 volts to accelerate the ions

Developments of Television

AN application of science has enabled a chairman of a company to become a historic figure. At the annual general meeting of Baird Television, Ltd., held in a theatre in the west end of London on March 20, the shareholders heard and saw distinctly the chairman address them from a studio at the Crystal Palace, nearly eight miles distant. To the shareholders, and afterwards to representatives of the Press, the Baird Company arranged a programme of transmissions by radio from the Crystal Palace to enable the audience to see persons talking on various subjects, a cartoonist sketching at his easel, excerpts from popular films and 'still' pictures. All these items were reproduced in the receiver with sufficient detail for an audience of more than a hundred persons to 'look in', although the receiver was devised for use in the home rather than a theatre. The success of these demonstrations is attributed to the state of perfection of the large cathode ray oscillographs made exclusively for the Baird Co. by the research staff of a British industrial concern, the excellence of the photoelectric cells in use at the transmitting end, and the construction of amplifiers which are capable of dealing without phase distortion with a range of frequencies from 25 to 1,000,000 cycles per second. The subject matter to be televised is divided up into 180 lines (or strips) corresponding to 24 times the definition obtainable with the old 30-line apparatus. Vision is being transmitted from a dipole aerial on a wave-length of 6·0 metres, and sound on 6·25 metres.

JUDGING from the demonstrations given last week, the Baird Company's engineers have successfully overcome interference effects due to motors, lifts and other electro-magnetic disturbances met with at these short wave-lengths. A series of experiments have been carried out to ascertain the effective range of reception, as a result of which it is claimed that the Crystal Palace transmitting station can provide an ultra-short wave high definition television service for the whole of the Greater London area, which includes a population of about eight millions. Capt. A. G. D. West, who joined the board of the Baird Company last June to direct its technical development, is to be warmly congratulated on his achievement; and the Company on the first public demonstration of the broadcasting possibilities of high-definition television. We understand that a demonstration will shortly be given of the intermediate film-method, described by Major A. G. Church in NATURE of September 30, 1933, by means of which televised images of topical events will be thrown on screens in cinema theatres, as well as on home-receivers within a few seconds of their occurrence. Another series of experiments on a new system of 'scanning' invented by Mr. Baird is nearing completion. These experiments aim at securing sufficient illumination in a studio to enable 'crowd' scenes to be televised directly with detailed fidelity.

Statistics in India

IN a paper on "India's Trade and Industrial Statistics", read before the Royal Statistical Society on March 20, Sir H. A. F. Lindsay, the Government of India Trade Commissioner in London, pointed out that progress in the compilation and preparation of official statistics in India has been from departmental to expert control. In 1871, when Sir William Hunter was appointed as the first Director-General of Statistics, the local authorities submitted their statistics to the appropriate Government department, which was responsible for tabulating and publishing them. Afterwards, expert control was gradually introduced, and now the Director-General is directly responsible for compilation and review. A new series of monthly statistics recently introduced relates to the output of the more important Indian industries and includes jute manufacture, paper, cement, matches, sugar, iron and steel, kerosene, petrol, sulphuric acid and sulphate of ammonia. In addition, cotton spinning and weaving statistics have been collected and published for many years past. The main difficulty has been to obtain statistics of the output of the numerous cottage industries which exist alongside modern large-scale factories, sometimes in active competition with those factories and sometimes catering for quite a different class of consumer. The Indian factory, however, provides a useful unit for the collection, compilation and publication of statistics of industrial output, and India has made a good start in this direction. There are many countries of no little industrial importance which have not yet made comparable efforts in the sphere of industrial statistics.

Origin of Bronze

AT a meeting of the Newcomen Society held on March 21, three short papers were read. The first of these, entitled "The Origin of Bronze", was by Prof. C. H. Desch, who gave an account of the results of the inquiries made for the committee of the British Association appointed to investigate the sources of the copper used by the Sumerians. Many specimens of objects found recently at Ur, Kish, Tell Asmar and other places have been analysed, and earlier analyses have been critically examined. A striking discovery is that true bronzes were made at a very early date and some of these contain certain 'key' elements, such as nickel and arsenic. So many of the early Mesopotamian objects examined contained small quantities of nickel that a search was made for copper ores containing nickel. One ore was found, accompanied by slag, at Jabal al Ma 'adan, in the State of Oman, and there are reasons for supposing this was a source from which the Sumerian cities drew their copper. Bronze, said Prof. Desch, must have originated in the East, and for further light on its origin an examination of ores from such places as Anatolia, northern Persia and Baluchistan must be made.

Early Dredging Machine

ANOTHER paper read at the meeting of the Newcomen Society on March 21 was by Mr. G. Bathe and dealt with the dredging machine of Oliver Evans. Oliver Evans was one of the outstanding pioneers of American engineering, constructing machinery for flour mills and introducing high-pressure steam engines. In 1804 the authorities at Philadelphia commissioned him to construct a steam dredging machine which, because it could propel itself on land and in the water, Evans called the *Orukter Amphibolos*. Evans died, a disappointed man, in 1819 Before his death he destroyed a lot of drawings, and with them probably was lost the sketches of his dredger, the details of which to-day are very imperfectly known.

A Vitamin A Concentrate of High Blue Value

IN *Science* of March 16, p 255, Prof H N. Holmes, in association with H Cassidy, E Hartzler and R Manly, reports the preparation of a concentrate of vitamin A having a blue value of 144,000, that is, 14,400 times greater than the blue value of an average good medicinal cod liver oil The starting material was the non saponifiable fraction of halibut liver oil This was chilled in methyl alcohol solution, to freeze out cholesterol, etc , filtered cold under nitrogen, transferred to pentane by addition of water, dried over anhydrous sodium sulphate and then, in pentane solution, cooled to about - 70° C with the aid of carbon dioxide snow mixed with alcohol and again filtered, with careful exclusion of oxygen The cold pentane solution was next filtered through a Tswett column of very specially prepared carbon and washed completely through with pure pentane The product obtained was a pale yellow viscous oil, different preparations showed blue values ranging from 105,000 to 144,000 The authors have not yet had time to analyse their concentrate or determine its molecular weight, spectral absorption bands, extinction coefficient or biological potency Further reports of their work will be awaited with interest

Recent Acquisitions at the Natural History Museum

AMONGST recent accessions to the Zoological Department of the British Museum (Natural History) is a valuable collection of mammals, including a large series of duikers and some specimens of the giant forest hog, which has been received from Mr G Foster, assistant game warden of Uganda A small collection of important Russian mammals, which has been received in exchange from the Moscow Museum, contains specimens of *Dipus*, *Spalax*, *Citellus*, *Ochotona*, *Alactagulus*, and *Cricetulus* As a gift from the trustees of the estate of the late Mrs. Mary Joicey, the Department of Entomology has received the most valuable present of butterflies and moths to reach it since the War The collection comprises more than 300,000 specimens and includes the types of 3,000, descriptions of which were published in the main in the *Bulletin of the Hill Museum* During his life-time, the late J J Joicey probably did more to stimulate the study of butterflies and moths, especially those of Africa, than any other private individual in Great Britain The Department of Geology has received the skull of a child, about six years old, of the extinct Neanderthal race, discovered by Miss Garrod in 1926 in a cave near the Devil's Tower, Gibraltar.

IN the Department of Mineralogy 474 individual masses of meteoric iron with a total weight of 165½ lb., from the meteorite craters at Henbury, Central Australia, have been received by exchange from the Kyancutta Museum, South Australia The larger masses weigh 46½ lb , 25½ lb. and 24½ lb , the majority are small twisted pieces (meteoric shrapnel) torn from the main masses by the force of the explosions that made the craters This completes a unique display of 1,000 lb of material collected from the Henbury craters Large blocks of long-fibre satin-spar (gypsum) from East Bridgford, Nottinghamshire, have been presented by Mrs A Coville. This material is exported to the United States for the fashioning of small fancy articles, which are sold at Niagara Falls, the material being stated to come from under the Falls This export resulted from an inquiry from the United States made to the Museum about twenty years ago Mr W C Barton has presented to the Department of Botany about 8,500 sheets of flowering plants The remainder of his herbarium will be handed over shortly The present instalment includes the genus *Hieracium* and the families Ranunculaceæ to Rosaceæ with the exception of the genus *Rosa*, which was presented some years ago, and the genus *Rubus*, on which the donor is specialising in collaboration with the Rev. H J Riddelsdell The herbarium includes those of H J Riddelsdell and Mrs Foord Kelsey, the first, which is large, is particularly rich in Gloucestershire and South Wales, and the second in Berkshire, plants The first portion of the lichen herbarium of Mr D A Jones has been purchased This includes nine hundred British specimens and five hundred European Many of the British specimens are those on which records are based, and the collection supplements the very extensive Museum collections Among the purchases is a set of 149 flowering plants from Galapagos Islands collected by H J F. Schimpff

British Polar Year Expedition, 1932–33

THE Symons Lecture of the Royal Meteorological Society was given on March 21 by Mr J M Stagg, who spoke on "The British Polar Year Expedition, Fort Rae, Canada, 1932-33" The activities during the International Polar Year 1932-33 really constituted a jubilee repetition on a more extensive and intensive basis of a co-operative scheme of observational work in meteorological and allied sciences so fruitfully carried out by fifteen countries during the First Polar Year As in that year, 1882-83, part of Britain's share in the new international effort consisted in equipping and maintaining a station at Fort Rae, a trading outpost of the Hudson's Bay Company on the Great Slave Lake, north-west Canada. The programme of work of the party of six, who remained at Rae from July 1932 until September 1933, consisted primarily in obtaining as complete records as possible of the main elements in meteorology, terrestrial magnetism, aurora and atmospheric electricity, and the proximity of Fort Rae to the zone of maximum auroral frequency around the polar cap made the auroral investigations specially important. Methods of parallactic photography were employed to determine the precise position of the aurora in space The information brought back will be studied in conjunction with similar data gathered by the forty-six other co-operating countries with the view of obtaining fuller insight into the synchronous large-scale events in meteorology, magnetism and aurora, over the earth and in the atmosphere up and into the conducting layers. A large amount of material is also available for the study of the interrelationships among the varied phenomena observed and recorded during the year's activities

The New Coast-line of Antarctica

FURTHER information has come to hand concerning Consul L Christensen's discoveries in the Antarctic referred to in NATURE of March 17, p 409 Princess Astrid Land, as it was named, is now reported in the *Times* to lie in about long 86° 45′ E. and a little south of the Antarctic Circle This is to the west of and adjoining Kaiser Wilhelm Land, discovered by Dr E von Drygalski in 1902, and east of Princess Elizabeth Land, discovered by Sir Douglas Mawson in 1931 The land was sighted from an aeroplane from a distance and reported to rise for a distance of about 150 miles It is further reported that the Douglas Islands, off MacRobertson Land, do not exist Consul Christensen then took the *Thorshavn* eastward and reports that in lat. 71° 44′ S, long 134° 11′ E (? W) his seaplane could find no land to the south Proceeding via Peter Island, the ship rounded Cape Horn, discovering a new bank to the south, and made for Montevideo A number of soundings were taken in hitherto uncharted waters

Early Science in Poland

A STUDY of the development and position of science in Poland up to the end of the sixteenth century is given by Prof Kazimierz Dobrowolski in the recent issue of *Nauka Polska* (vol. 17; 1933), an annual publication devoted to the organisation and progress of science in Poland Prof Dobrowolski's account (132 pages) of Poland's contributions to early science is especially detailed for the sixteenth century itself and is well documented throughout It refers not only to the natural sciences, so far as they had then developed, but includes also incursions into theology, philosophy, logic, law and history It is evident that 'science' as understood in Poland, and in Europe generally for that matter, up to the seventeenth century was closely associated with alchemy, astrology and occult practices. But towards the close of the period under review, Prof. Dobrowolski points out that real scientific inquiries were being prosecuted in Polish centres of learning, so far as political upheavals permitted. The work of Copernicus is not only important in itself but also because it was followed by that of Francis Bacon, Galileo, Descartes and others. Early English and French contributions to scientific knowledge, for example, Roger Bacon's discoveries and writings and those attributed to Thomas Aquinas, had reached Poland and exerted some influence upon thought there The same volume of *Nauka Polska* contains some notes by Dr M. Wolfke on certain recent developments in pure and applied physics and another contributor describes life in scientific circles at Lodz.

High-Voltage Testing Equipment

ECONOMICAL considerations are leading electrical engineers to use very high voltages for transmitting electrical energy over long distances. The accessories used with high-voltage cables or overhead lines require to be specially tested This has made it necessary to build high-voltage laboratories and to design insulating devices which will withstand these high pressures. In the early days of testing, the perfection of a testing set was judged mainly by the length and appearance of the spark and the loudness of the noise it made Nowadays these measurements have to be made with high accuracy in accordance with stringent specifications On the result of the acceptance tests, errors of a few per cent may turn the scale for rejection, leading to losses of thousands of pounds to the manufacturer. In certain cases discrepancies of ten per cent are shown in the results obtained in different laboratories, leading to considerable dissatisfaction

IN a paper on high voltage testing read on December 21 to the *Institution of Electrical* Engineers by B L Goodlet, of the Metropolitan Vickers Electrical Co, Ltd, it is shown that the discrepancies are mainly due to badly designed equipment and insufficient knowledge of the performance of the testing set under various conditions They also arise sometimes from differences in the technique used in testing Single units for testing purposes are usually built for a million volts, but it is often more advantageous to utilise the well-known cascade connexion which produces the required total voltage by adding up the individual voltages of several smaller units The high voltage and low power rating of these transformers lead to difficulties in designing them The authors illustrate this by showing oscillographic records of the distorted wave forms of the current and voltage sometimes obtained In the third part of the paper a complete mathematical and experimental discussion is given of the impulse generator.

Economic Survey of 'Agriculture in the East of England

AN excellent economic survey, the second of the series, based on a sample of more than a thousand farms, has recently been published (University of Cambridge. Department of Agriculture, Farm Economics Branch. Report No 21 'An Economic *Survey of Agriculture in the Eastern Counties of* England, 1932" Pp. vi + 89. Cambridge. School of Agriculture, 1933 2*s*. 6*d* net) As a record of what is actually happening to the individual units of agriculture in the eastern counties of England, it could scarcely be bettered Reality is an excellent antidote to indiscriminate theorising in any subject; surveys such as this enable the hard facts of an industry of small units like agriculture to be ascertained Without a factual basis of this type there can be no sound future planning or adequate criticism of past planning.

THE broad facts revealed by the survey are sufficiently disquieting The depression of agriculture is common knowledge; here the extent of the depression is measured. Except for the wheat deficiency payments, the year 1932 appears to have been even worse than 1931. Of the individual farms the most profitable are the most progressive, those which aim at a high level of productivity and low labour costs per unit output; but specialisation, which would lead to the most complete mechanisation, is unsuccessful, for labour and by-products cannot be efficiently utilised The general purpose farm is the one most adapted to economical production. The whole report gives a picture of economic laws striving to operate, but without their natural consequence, the elimination of the least efficient. The moral of it all is plain: overproduction of food. Whether the English farmer should be allowed to suffer as a result of what is after all a world phenomenon is a matter of politics. What is abundantly plain is that salvation is only to a very limited extent in his own hands Mere increase in efficiency is patently not enough. In fact such increase, if world wide, will merely aggravate the disease

Recent Research in Building Practice

THE annual report of the Building Research Board for 1933 (London: H.M. Stationery Office, 2*s* 6*d*. net) contains an account of several interesting investigations. The failure of lime-plaster ceilings on lathing, whilst of frequent occurrence, is not generally due to defective materials, but to hasty work and disturbance by other types of work in the building at a time when the plaster ceilings are very sensitive to vibration. Damp walls are often caused by penetration of rain through fine cracks between the bricks and mortar. Most colourless waterproofing materials are ineffective, but an imitation stone paint showed a good resistance to weathering. Experiments on heating showed that intermittent heating from 9 30 a.m. to 5 30 p m required only three quarters of the electrical energy for continuous heating, although the latter method has been said by heating engineers to be equally economical. Testing of bricks by exposure, and of concrete piles by an ingenious piezoelectric method, are described

Science Abstracts

THE issue of the two index parts of *Science Abstracts* completes the physics and the electrical engineering volumes for 1933. More than 260 periodicals are dealt with by the editor and his 71 abstractors for physics and 57 for electrical engineering Each volume has between 30 and 40 more pages than the volume for last year. 5,491 abstracts of average length 0 247 page relate to physics and 3,078 of average length 0 257 page to electrical engineering. In each case the average length is nearly the same as last year. Reference to the abstracts is greatly facilitated by the extensive indexes provided. In the physics volume the subject index covers 208 pages and there is a key to the subject index of 15 pages and an author index of 76 pages. In the electrical engineering volume the subject index has 109 and the author index 45 pages, but there is no key. Each volume seems indispensable to the physicist or to the electrical engineer who wishes to keep himself up to date, but while every member of the Physical Society and possibly of the American Physical Society gets a copy of the physics volumes the Council of the Institution of Electrical Engineer, reported in May last that only 9 per cent of its members subscribed for copies of the electrical engineering volume.

German Association of Men of Science and Physicians

THE German Association of Men of Science and Physicians (Gesellschaft Deutscher Naturforscher und Ärzte) is modifying its policy with the view of overcoming excessive specialisation. It is proposed to emphasise the tasks and problems common to many or all branches of science and medicine, and to promote discussion on these common topics on the widest possible basis. The annual meeting of the Association will last not more than three and a half days. The Council of the Association will only arrange the general sessions, the main group and joint sessions, and popular evening lectures The general sessions will be devoted to topics in which some definite results have been reached or to problems of immediate importance. If discussion does not follow these addresses by selected speakers, the same theme may be handled more freely in joint sessions of sections. The Council will abandon the attempt to arrange meetings of the separate sections, leaving them to deal individually with the local committee. It has been the custom for some years past that allied and associated societies should meet at the same place, and either before or after the formal meetings of the Association This custom is to be continued at the next meeting in Hanover (Sept 16–20, 1934), and with the help of the local committee. An innovation is the *Zweckverband* of German scientific and medical congresses, the aim of which is to maintain contact between these congresses so that whilst specialisation goes forward they shall not be shut off from each other The purpose of this union is to publish the dates, places and programmes of these congresses; for example, various medical congresses take place in April and May next

Royal Geographical Society's Awards

HIS MAJESTY THE KING has approved the award of the Royal medals as follows *Founder's medal* to Mr Hugh Ruttledge, for his journeys in the Kumaon and Garwhal Himalaya extending over eight years and his leadership of the Mount Everest Expedition, 1933; *Patron's medal* to Capt. Ejnar Mikkelsen, for his explorations in the Arctic between 1900 and 1912 and for his work in Eskimo re-settlement on the east coast of Greenland The Council has made the following awards: *Victoria medal* to Mr. Edward Heawood, for his work on the history of geography and cartography and his devoted service to the Society as its librarian; *Murchison grant* to Mr. John Rymill, for his work in Greenland and leadership of the party after the death of Mr. H. G. Watkins on his second expedition; *Back grant* to Dr. D. N.

Wadia, for his studies of the Himalayan axis and other problems of Indian geomorphology of importance to geographers; *Cuthbert Peek grant* to Mr Edward Shackleton, to assist him in his proposed expedition to Ellesmere Land, *Gill memorial* to Mr W B. K. Shaw, for his explorations and studies in the Libyan desert

The Night Sky in April

JUPITER is now exceedingly well placed for observation, as it is in opposition on April 8 It is a very conspicuous object in the sky, rising a little after sunset The bands and satellites make this planet a very interesting telescopic object. The planetary nebula, N.G.C. 3242, R A 10h 21m, Dec 18° 15′ S, a little south of μ Hydræ, is now conveniently placed for observation It is of slightly elliptical shape and bears magnifying well There are two clusters visible to the naked eye which repay examination with a small telescope. These are N G C. 2632 at 8h 35m. and 20° 15′ N (Præsepe), and N.G C 2168 at 6h 4m. and 24° 20′ N The last mentioned is in Gemini, and now appears in the western sky in the early evening

Announcements

THE Chemical Society will celebrate the centenary of the birth of Mendeléeff in 1834 by a meeting, on April 19 at 8 p m., to be held in the lecture theatre of the Royal Institution, when Lord Rutherford will deliver a lecture entitled "The Periodic Law of Mendeléeff and its Interpretation" The lecture is open to fellows of the Chemical Society and their guests.

PROF J C MCLENNAN will deliver the twenty-fifth Kelvin lecture before the Institution of Electrical Engineers on April 26, taking as his subject "Electrical Phenomena at Extremely Low Temperatures"

PROF JOHAN HJORT will deliver the Huxley Memorial lecture of the Imperial College of Science at the Huxley Building, Exhibition Road, South Kensington, S.W.7, on May 4, at 5 30. The subject of the lecture will be "The Restrictive Law of Population". Prof Hjort is professor of marine biology in the University of Oslo, and is well known for his work on the development of the fishing industry and oceanographical research in North European, Atlantic and Canadian waters. He was elected a foreign member of the Royal Society in 1916.

SOME details were given in NATURE, of March 17, p. 412, of the mirror which is to be made for the new 200-in telescope for the California Institute of Technology. According to the New York correspondent of the *Times*, the glass was poured on March 25, an operation which took ten hours to complete, ten months are to be allowed for the twenty tons of glass used to cool

MR. EDWIN THOMPSON, of Liverpool, has been selected by the Council of the Society of Chemical Industry as president for the year 1934–35. He will take office at the annual meeting of the Society which is to be held in Cardiff on July 16–20. Mr. Thompson is governing director of Messrs. Thompson Capper Wholesale, Ltd., manufacturing chemists of Liverpool, and has for many years been associated with the work of the Society He is on the General Committee of the British Association, and at the Liverpool meeting in 1923 he did valuable work as honorary secretary He was president of the British Waterworks Committee when in 1930 it held its annual meeting in Liverpool Mr Thompson originated the idea which eventually led to the formation of the Lancashire Industrial Development Council

AT the first scientific meeting of the Microchemical Club held at the Lister Institute on March 17 the following officers were elected for the year 1934–35: *Chairman*, Dr Janet Matthews (Imperial College of Science); *Hon Treasurer and Librarian*, Dr L H. N Cooper (Marine Biological Laboratory, Plymouth), *Honorary Secretary*, Dr S J. Folley (National Institute for Research in Dairying, Shinfield, near Reading)

THE Ministry of Agriculture and Fisheries has recently issued two new Advisory Leaflets, "Turnips, Swedes and Kohl-Rabi" (No 189) and "Bracken" (No 190) The former discusses the soils and climate most suitable for the growth of the three root crops mentioned, their varieties and cultural treatment. Many useful practices are described, and the subject matter is quite up-to-date The leaflet on bracken shows that this plant has a few slight uses—as bedding and food for pigs—but causes damage far beyond its benefits. The chief methods of eradication are cutting off the shoots in June for two or three years in succession, and the application of lime and phosphate It is suggested that dragging a chain harrow over the newly-emerged sprouts in early spring is also a good method of control

MESSRS. DULAU AND COMPANY, LTD, of 32 Old Bond Street, London, W 1, have recently published Catalogue No 218, containing an extensive list of books on botany and gardening, which they have for sale. More than eight hundred volumes, mainly of historical interest, are enumerated, and a further extensive list of standard modern works on gardening is given Such outstanding contributions to botanical science as Nehemiah Grew's "Anatomy of Plants", several writings of Linnæus and a few early "Herbals" are combined with more modern writings

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—A mechanical engineer at the Royal Arsenal, Woolwich—The Under-Secretary of State (M G O 4), The War Office, London, S W.1 (April 7). A head of the Physics Department, a lecturer in electrical engineering, and a teacher of geometrical drawing and elementary mathematics at the Wigan and District Mining and Technical College—The Principal (April 9) A lecturer in geography at the Homerton Training College for Women, Cambridge—The Principal (April 23) A lecturer in chemistry at the University of Reading—The Registrar (May 7). A resident woman tutor in mathematics at the Edge Hill Training College, Ormskirk—The Principal.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Œstrogenic Hormone in the Urine of the Stallion

IN further investigations on the œstrogenic hormone, which to a large extent is excreted in the urine of the stallion[1], we have examined the influence of this hormone on the secondary sexual characteristics, especially on the mammary gland By the use of follicular hormone, Laqueur was able to induce lactation of male guinea pigs We have now observed the same effect with the hormone obtained from the urine of the stallion and in the actual cases the lactation of the male animals has continued for 21 days

Another typical effect of the follicular hormone, the hyperpigmentation of the mamillæ and the areolæ of the nipples (Bloch and Schrafl), is also exhibited after the injection of the œstrogenic hormone of the urine of the stallion These investigations show that all the *biological reactions which are characteristic of the follicular hormone are exhibited by the œstrogenic hormone of the urine of the stallion*

How can the occurrence of so great a quantity of œstrogenic hormone in a male organism be explained ? I believe that the female hormone which is regularly present in the male organism represents a normal physiological product of the metabolism of the sex hormones, especially since—due to our present chemical knowledge (Butenandt, Marrian, Doisy)—a conversion of the male hormone into the female one appears to be quite possible. I am further of the following opinion · the metabolism of the sex hormones is, in the main, the same in both sexes. At first, the male sex hormone is synthesised from substances which are still unknown, and the male hormone is then converted into the female one The specific sexual characterisation is solely due to a quantitative regulation of this general process of metabolism In my opinion, the observations with male equines support this hypothesis from the biological point of view From the fact that production of the female hormone in large quantities in the stallion occurs only during sexual maturity—when the male hormone is produced—it follows that there exists a connexion between the male and the female hormone It is possible that in the testes of the stallion—as compared with other organisms—a very great production of male hormone occurs, and that this surplus of male hormone is immediately destroyed by converting it into female hormone and then rapidly excreting the latter It is impossible to say why this hyperproduction is characteristic of equines The fact that a not inconsiderable amount of male hormone is to be found in female animals, including women (Loewe, Tschernung), is also in harmony with this hypothesis.

The male hormone represents an intermediate product in the formation of the female one. The regular occurrence of female hormone in the male organism is explained as due to the conversion of part of the male hormone into the female one. In the female organism the male hormone is supposed to constitute a previous product of the female hormone and in the male organism the female hormone is supposed to constitute a degradation product of the male hormone. The dehydrogenation products which Girard has isolated from the urine of pregnant mares (equilin, hippulin and equilenin) do accordingly constitute the final products (which at the present time are known) of the degradation series of the male hormone

Metabolism of sex hormones outside the sexual glands (extragonadial metabolism) can also occur and this has been the object of a joint communication of H. v Euler and myself[2]

BERNHARD ZONDEK

Biochemical Institute,
University of Stockholm.
Feb. 22

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[1] NATURE, 133, 209, Feb 10, 1934

[2] *Scand Archiv Physiol*, 67, 261, 1934

A Rapid Test for the Diagnosis of Pregnancy

CURRENT biological tests for the diagnosis of pregnancy or detection of ovary-stimulating substances in gland extracts and body fluids have the main disadvantage that several days must elapse before a result can be obtained Attempts have been made to remedy this by making use of the doe rabbit, because in this animal a response (ovulation) can be obtained in less than 14 hours[1]. The rabbit, however, requires a good deal of care in order to obtain consistent results. It is essential to know the previous history of does employed, and preferably only to use them a short time after parturition. Even so, variation in response to injection may be so great as to necessitate the use of more than one doe in order to be sure of the result

The test described in the present note depends upon the observation by Hogben[2] that extraneous ovulation in the South African clawed toad (*Xenopus Lævis*) can be induced by injection of extracts of the anterior lobe of pituitary. *Xenopus* can be obtained easily and cheaply in large numbers Several hundreds can be kept without difficulty at the sole cost of a few handfuls of raw meat once a week, provided that they are kept in a warm well-lit room and that their water is changed after feeding Ovulation does not occur spontaneously in captivity Ova shed as a result of injection are clearly visible and extruded in large numbers. No doubt exists, therefore, as to the validity of a response

During the past two years, work has been carried out on the use of *Xenopus* for detecting and estimating ovary-stimulating substances in tissue extracts and body fluids such as pregnancy urine The following main points have emerged[3]

(*a*) At a temperature of 20°–25° a single injection of an active preparation into the lymph sac is followed in the great majority of cases by complete ovulation within 9 hours. Very often a response is obtained in less than 6 hours.

(*b*) A given batch of toads can be used repeatedly, provided that a rest of at least one week is allowed to elapse between successive injections

(*c*) A definite quantitative relationship holds between dosage and response.

As a result of the first observation, a test for early pregnancy has been elaborated, the exact procedure of which depends upon the time which has elapsed from the last missed menstrual period :—

(1) If one month or more has elapsed, untreated urine from the suspected case is used. Ten toads

are injected in the lymph sac with 1 ml. A positive diagnosis is made if ovulation occurs in at least 5 out of 10 animals within 9 hours. The correct temperature is obtained by keeping vessels containing the toads in a room heated to 20°–25° by means of an electric fire.

(2) If less than one month has elapsed, a sample of 100 ml of urine is precipitated with acetone and centrifuged The residue is suspended in 10 ml. of distilled water and 1 ml of the suspension injected into each of 10 toads A positive result is indicated as before This procedure is necessary owing to the facts that in very early pregnancy there is an insufficient amount of ovary-stimulating substance in 1 ml. of urine to produce a response, and that a volume of fluid greater than 2 ml cannot be injected into the lymph sac without risk of non-absorption

A full account of this work will appear later So far no incorrect diagnosis has been made In view of the quantitative nature of the test, it is hoped to distinguish normal early pregnancy from ectopic pregnancy or conditions such as hydatidiform mole

C W BELLERBY

Department of Social Biology,
University of London.
March 19

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[1] Bellerby, C W, *J Physiol*, 67, *Proc* xxxii, 1929
[2] Hogben, L T, *Proc Roy Soc S Africa*, March, 1930
[3] Bellerby, C W, *Biochem J*, 27, 615, 2025, 1933

Uniformity in Bibliographic Particulars

THE excellent letter from the librarian of the John Innes Horticultural Institution, published in NATURE of March 10 (p 380), is welcome to the Committee on Zoological Bibliography and Publication appointed by the British Association in 1895 and still working. Most of Miss Schafer's recommendations have from time to time been made by this Committee in its published reports as well as in its considerable correspondence. May I dot the i's of one or two ?

In the order of citation the date should occupy a more prominent position in making references my Committee would place it immediately after the author's name, in catalogue slips it is usual to place it at the end In any case the month, and even the day when known, should precede the year.

The practices to which Miss Schafer rightly objects are sins of omission ; but there are sins of commission Details given by a publisher, or appearing on the printed cover, should never be taken at their face value, until one has learned by experience that the particular publisher or editor is to be trusted, and even of them the most accurate can make mistakes. The printed date, as Miss Schafer has noted, is frequently wrong ; I have catalogued one paper that had four dates—all incorrect. When priority is in question a printed date inclines to be earlier than the correct one ; but textbooks tend to bear a date later than the actual publication. The title on the wrapper is often inexact and sometimes absurd ; it is made up by the printers. The use of the term 'plate' is frequently incorrect. A plate, properly speaking, is an addition or insertion and not part of the printed sheet ; the fact that an illustration occupies a whole page does not make it a plate, neither should an inserted plate bear a page-number. But the issue of plates without any numbers at all is probably more exasperating, only outdone by the numbering of some and not of others.

For the worker, as distinct from the cataloguer, it is a convenience to have on every page-opening the name of the journal, the volume number, and the date, as well as the running title of the article But even the cataloguer benefits by this when separates have been formed by the breaking up of a volume

Printers have a habit, not only of re-paging, but also of rehandling the type so that a paragraph originally on, say, p 15 is shifted to p 14 They may even change the numbering of the text-figures. Printers cannot be expected to know better ; authors rarely have a say in the matter, therefore my Committee has always appealed to the editors. Editors unfortunately are not permanent, so that one has to be constantly repeating one's protest. It is comforting to find that one is not alone

Just one point in Miss Schafer's letter leaves me uncertain Why does she call roman numerals "eye-straining" ? I will grant that the present generation does not seem educated up to them, but they have their advantages. Instead of printing 'Series 3, vol. 12, pages 31–43, plates 7–10', it is convenient to print or write '(3) XII, 31–43, vii–x' The modern use of clarendon arabics for the volume number may be an improvement, but it involves intermittent recourse to a different fount by the compositor, which must be rather worrying to him

F A BATHER

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Diplogen and Fish

IN recent months we have been carrying out experiments on the behaviour of fish in heavy water We find that goldfish (*Carassius auratus*) behaved quite normally in the heavy water in which they were kept As heavy water was to be used as indicator of normal water, we had to carry out our experiments in water containing only 0 5 mol. per cent of diplogen, and it is therefore still possible that a higher concentration of this isotope in water exerts effects upon fish

The aim of our experiments was to follow the exchange of water between the fish and their surroundings, using heavy water as an indicator of the movement of the total water The use of radioactive isotopes for such purposes is well known While the latter are practically chemically identical, and as such are entirely trustworthy indicators, that is not the case with the isotopes of hydrogen Heavy water is, therefore, only to be used with great caution as an indicator of ordinary water However, when using very dilute solutions of heavy water, we may expect that the rate of exchange of heavy water molecules between the fish and its surroundings will not be very different from that of the normal water molecules. By measuring the speed at which the heavy water enters the body of the fish we can therefore conclude at what rate approximately the exchange of water between the fish and its surroundings takes place.

Some twenty fish having a total volume of about 10 c.c were kept in about 60 c c. of water containing 0 5 mol. per cent diplogen water. After a certain time the fish were removed and the decrease of the density of the surrounding water was determined. The fish were then placed in normal water, and the rise in the density of the latter due to the entrance of heavy water molecules leaving the body of the fish was determined The results are as shown in the accompanying tables.

TABLE 1

Rate of entrance of heavy water into fish

	Time in hours	Decrease of the heavy water content of the surrounding water	Decrease expected in the case of equal distribution of the heavy water between fish and surrounding water
I	1	32 p c	30 p.c
II	4	32 p c	29 p.c
III	15	33 p c	30 p c

TABLE 2

Rate of loss of heavy water by the fish

	Time in hours	Initial heavy water content of the fish	Decrease of the heavy water content of the fish after the experiment	Decrease expected in the case of equal distribution of heavy water between fish and surrounding normal water
I	1	0 27 p c	68 p c	51 p c
II	4	0 27 p c	68 p c	67 p c
III	10	0 26 p c	86 p c	86 p c

It follows from the above that, at least in a small fish, within a few hours nearly all the water molecules leave the body of the fish, making way for water molecules derived from the surrounding water. It should be borne in mind that most fish contain about 80 per cent water.

G HEVESY.
E HOFER.

Institute of Physical Chemistry,
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Feb 20

Band Spectrum of Aluminium Deutride

BEING in possession of heavy water obtained by the electrolysis of some hundreds of litres of water, kindly furnished us from Norduska Syrgasverken in Örebro, we have started investigations on the isotope effects in the band spectra of hydrides The following preliminary results are given for the spectra of AlH and AlD; the former spectrum is reanalysed in order to get more exact data for comparison.

Table 1 gives the origin of the bands in $^1\Pi \rightarrow {}^1\Sigma$ from measurements in the second order of a 21-ft. concave grating (dispersion 1A /mm) The bands of the new AlD molecule are indicated by asterisks.

Table 1

v'' \ v'	0	1	2
0	23470 91 23536 79*	24554 29 24379 89*	
1	21845 73 22354 75*	22929 11 23197 85*	—— 23868 54*
2		21359·81 22045 29*	—— 22715 96*
3		19844·94 20921·67*	

We have applied the theory on isotope effects in band spectra to the normal state $^1\Sigma$ as being most favourable on account of its regular structure. The harmonic frequencies ω_e of the nuclear vibrations and their anharmonic corrections are given below:

AlH		AlD	
ω_e	= 1682 45 cm $^{-1}$	ω_e^i	= 1212·04 cm.$^{-1}$
$\chi_e\omega_e$	= −29 089 ,,	$\chi_e^i\omega_e^i$	= −15 145 ,,
$y_e\omega_e$	= 0 242 ,,	$y_e^i\omega_e^i$	= 0 090 ,,

Our third order polynom, representing the vibrational levels in $^1\Sigma$, does not converge at high v numbers and must therefore be completed by terms of higher order to fit into the known value of dissociation (D = 3 1 volts). The small corrections to be applied on the frequencies given above are, however, of minor importance in this connexion

From analysis of the band structure we have calculated the coefficients of rotation in $^1\Sigma$ up to the sixth order in $(k+\frac{1}{2})$ as follows:

AlH		AlD	
B_e	= 6 3955 ± 0 0003	B_e^i	= 3 3190 ± 0 0003
α_e	= 0 1850	α_e^i	= 0 0689
D_e	= −3 8 × 10^{-4}	D_e^i	= −0 98 × 10^{-4}
F_e	= 3 × 10^{-7}	F_e^i	= 0·05 × 10^{-7}

These data applied to the general problems on isotopes are of interest as will be discussed below to some extent. Primarily, we assume that the mass-spectroscopic value based on the atomic weight of the heavy isotope of hydrogen 2 0136, obtained by Bainbridge[1] is correct. If this is true, ρ^2 = 0 51838 corresponds to the ratio of the reduced masses of the isotopic molecules as deduced from the atomic weights 1 00778 and 26 97 of hydrogen and aluminium respectively. Errors in the latter value amounting to 3 parts in 1000 will be of no influence on the value of ρ^2 given above. Now generally,

$$\frac{\omega_e^i}{\omega_e} = \rho \left(\frac{\varkappa^i}{\varkappa}\right)^{\frac{1}{2}}$$

where $\varkappa^i$ and $\varkappa$ are the forces of direction in the case of harmonic vibrations. As these forces are to be derived from the interaction between the charged particles in the molecule, the isotope principle requires their ratio to approach unity to a very high degree of exactness However, inserting our values for ω_e^i and ω_e ($\rho^2 = 0{\cdot}51898$), we find $\frac{\varkappa^i}{\varkappa}$ = 1 00057, corresponding to an increase in the binding forces of the nuclei at their position of equilibrium in AlD as compared to the ordinary AlH.

A similar effect appears in the values of the nuclear separations, as shown by finding the ratio of the moment of inertia ($B_e^i/B_e = \rho^2$) in both molecules. With the same assumptions as before, we get ρ^2 = 0 51896, corresponding to an approach of the nuclei in AlD amounting to 0·056 per cent, which means a small displacement of 9×10^{-12} cm.

On the other hand, rejecting the mass-spectroscopic value of ρ^2, our results point at an atomic weight for deuterium of 2·0113, far less than that found by Bainbridge At present, however, we postpone the discussion of the causes of these divergencies, awaiting the results of investigations of the band spectra of other deutrides (BiD, HgD, etc.) now in progress in this laboratory.

Details regarding the structure of the activated $^1\Pi$ state in AlD will be given later, after we have investigated the remarkable pressure effect which governs this rather unstable state. Incidentally, it may be mentioned that the measured Λ-doubling agrees with the formula: $T_d - T_c = q\, k(k+1)$, where q_{AlH} = 0·009 cm^{-1} and q_{AlD} = 0 00225 cm.$^{-1}$.

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[1] *Phys Rev.*, 41, 115, 1932.

Crystal Structure of 1, 3, 5-Triphenylbenzene

IN a recent communication on the crystal structure of 1, 3, 5-triphenylbenzene, Dr. Kathleen Lonsdale[1] discusses the results of recent X-ray measurements on the crystal and concludes that the planes of the benzene rings of the molecules cannot coincide with the (001) plane of the crystal, as has been suggested by earlier investigators, but must be inclined to this plane.

This conclusion is fully supported by the results of our magnetic measurements on this crystal, and the magnetic data further enable us to calculate approximately the inclinations of the benzene rings to the (001) plane. The crystal is orthorhombic and its principal gram molecular susceptibilities along a, b and c axes are

$$\chi_a = -141\,;\ \chi_b = -155;\ \chi_c = -309$$

respectively, in 10^{-6} C.G.S. E.M.U.

The c axis is thus an axis of approximate magnetic symmetry, the susceptibility along this axis being numerically greater than that along perpendicular directions by 161×10^{-6} per gram molecule. Had the planes of all the benzene rings in the unit cell been coincident with the (001) plane, the difference between the susceptibilities along the c axis and along perpendicular directions would have been much higher, namely, 216×10^{-6} per gram molecule. This shows that the benzene rings are inclined to the (001) plane, the angle of inclination θ being given by the relation $\cos^2\theta - \frac{1}{2}\sin^2\theta = \frac{161}{216}$; that is, $\theta = 24°$

The optical constants of the crystal also support the above orientation of the benzene rings The gram molecular refractivities (defined as usual by $R = \frac{n^2-1}{n^2+2}\cdot\frac{M}{\rho}$) of the crystal for vibrations along the a, b and c axes are[2]:

$$R_a = 115{\cdot}5\,;\ R_b = 115{\cdot}0\,;\ R_c = 77{\cdot}6$$

respectively, for the D lines. R_a and R_b are thus nearly equal and much greater than R_c, as we should expect If we assume all the benzene rings to lie in the (001) plane, and *neglect the mutual influence of the optical dipoles induced in the different benzene rings*, we obtain for the birefringence of the crystal

$$R_a - R_c = R_b - R_c = 65$$

The much smaller birefringence actually observed for the crystal, namely, $R_a - R_c = R_b - R_c = 38$, points to an inclination of the benzene rings to the (001) plane, at an angle θ determined, as in the magnetic case, by the equation

$$\cos^2\theta - \tfrac{1}{2}\sin^2\theta = \tfrac{38}{65}, \text{ or } \theta = 32°.$$

Since the mutual influence of the dipoles is by no means negligible as we have assumed in the calculation, this value of θ must be taken to represent only the *order of magnitude*, and is therefore not inconsistent with $\theta = 24°$ obtained from the magnetic data.

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[1] NATURE, 133, 67, Jan. 13, 1934.
[2] Groth, *Chem. Krist.*, 5, 342.

Production of Heat in Supraconductors by Alternating Currents

IT has frequently been suggested[1] that supraconductivity is a phenomenon not due to the normal electrons which cause ordinary electrical conductivity, but that one may have to take into account supraconducting electrons as opposed to the ordinary electrons Such a hypothesis would seem to be in accord with the observed fact that there is no discontinuity in the heat-conductivity at the transition point[2]. In this case the following method would seem to enable one to determine the number of supraconducting electrons.

If the electrons taking part in the ordinary conduction above the transition point preserve their properties below it, their damping, characterised by the specific electrical conductivity σ, would presumably not vary appreciably. This cannot be observed with direct current, since the supraconducting electrons prevent one applying the electrical field. With an alternating current of sufficiently high frequency, however, this screening effect is not complete on account of the inertia of the electrons; one might therefore expect an alternating current to produce motion of the normal conducting electrons with a consequent production of heat. By measuring this heat, it should therefore be possible to demonstrate the existence of these normal electrons and prove whether their general properties change at the transition point

For ordinary electrons the relation between the current density $\mathbf{J}$ and the strength of electric field $\mathbf{E}$ is:

$$\mathbf{J} = \sigma\mathbf{E}$$

If we take into account the existence of the supraconducting electrons, we must because of their inertia replace this equation by

$$\mathbf{J} = \frac{1}{\Lambda}\mathbf{E} + \sigma\mathbf{E} \qquad (1)$$

where the inertia term

$$\Lambda = m/ne^2 \qquad (2)$$

depends, apart from universal constants, only upon the number n of electrons per cubic centimetre

If we calculate the distribution of an alternating current in a supraconductor according to formula (1), we find that the current flows near the surface in a layer of finite thickness d. Considering in the first place not too high frequencies ν, such that $\sigma\Lambda\nu \ll 1$, and neglecting terms of second and higher powers in $\sigma\Lambda\nu$ (and the influence of the displacement current) we find

$$d = \sqrt{\Lambda c^2/4\pi} \qquad (3)$$

In this approximation the thickness is therefore independent of the second term in (1), that is, the term taking account of the normal electrons, and is also independent of the frequency[3].

This term is important, however, for the production of heat. While with direct current only the magnetic field $\mathbf{H}$ occurs in the layer, with alternating current an electric field $\mathbf{E}$ appears which is given by Maxwell's equation curl $\mathbf{E} = -\frac{\mu}{c}\mathbf{H}$. It is this which gives rise to the heat.

The amount of heat Q produced per unit volume in unit time (neglecting higher powers of $\sigma\Lambda\nu$) amounts to:

$$Q = (2\pi\nu)^2\sigma\Lambda^2\,\overline{J^2} \tag{4}$$

where $\overline{J^2}$ represents the mean value of J^2 averaged over the time By means of this equation we can therefore determine either the number n of supraconducting electrons (by (2)) or the thickness d of the layer in which the current flows (by (3)). In this effect, in contrast to others, the proportionality with ν^2 is characteristic. Thus a production of heat which might occur each time the supraconducting current was switched on would, of course, be proportional to ν only

For high frequencies, for example infra-red radiation, in which the value $\sigma\Lambda\nu$ is no longer small compared with 1, the inertia of the normal conducting electrons must be taken into account For at low temperatures the value of the normal conductivity is very large and therefore the inertia term is much more important than it is at room temperature In this case it is therefore necessary to distinguish between Λ_s and Λ_n, corresponding to the supraconducting and normal electrons, and formula (1) must be replaced by

$$\mathbf{J} + \sigma\Lambda_n\,\mathbf{J} = \frac{1}{\Lambda_s}\,\mathbf{E} + \sigma\,\mathbf{E}\left(1+\frac{\Lambda_s}{\Lambda_n}\right) \tag{5}$$

If the number of supraconducting electrons is small compared with the number of normal electrons ($\Lambda_s \gg \Lambda_n$), their influence at these frequencies will be so small that the absorption of infra-red radiation should be nearly the same both above and below the transition point

Though the conditions we have considered have been idealised considerably, yet it stands to reason that the supraconducting currents are not surface currents in the mathematical sense Once one admits any finite thickness for the layer in which the current flows (even though it be represented by a formula different from (2)), there must always be in the case of alternating current an inner electric field If therefore normal conduction electrons exist, we must expect a production of heat characteristic of each supraconductor

Experiments to measure this production of heat with the view of determining whether such normal electrons exist and, if a positive result were obtained, to make deduction of the number n of supraconducting electrons, or at any rate the thickness d of the layer, were carried out in Prof Simon's laboratory in Breslau in 1933[4] As they were prematurely interrupted, definite results are not yet available. They are being continued and it is hoped to report upon them in due course

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[1] W Meissner, "Ergebn. exakt Naturwissenschaften", 11, 251

[2] W J de Haas and H Bremmer, Comm Leiden, No. 214 *d*, 1931.

[3] This thickness is, of course, the same as that which has been calculated independently for direct current by R Becker, G Heller, F Sauter, *Z Phys*, 86, 772, 1933 These authors, however, do not take into account the possible existence of normal electrons, which are of no interest for direct current problems but would be fundamental if they exist for the effect we are considering here (Added in proof) Therefore W Braunbeck in a recently published paper (*Z Phys*, 87, 470, 1934) obtains no production of heat calculating the propagation of electric waves through a supraconductor without considering the existence of normal electrons

[4] Dissertation Breslau

Vitamin B_2 and the Pellagra-like Dermatitis in Rats

IN our first experiments on the concentration and isolation[1] of vitamin B_2, we failed to observe definite changes in the skin and fur, such as those described by J Goldberger and R D Lillie[2], and by H. Chick and M. H. Roscoe[3] and several other authors, in rats fed on diets containing the antineuritic vitamin in a purified form (for example, alcoholic extracts of wheat or maize, Peters's antineuritic concentrate from yeast, crystalline vitamin B_1 preparations). The flavin pigment was identified by us with vitamin B_2 by its growth-promoting properties. It was therefore a question for further investigation whether in these circumstances it was also identical with the 'anti-dermatitis factor' and in particular with the 'pellagra preventing factor'

The chief and obvious reason for designating as pellagra-like this peculiar condition produced in rats receiving the antineuritic vitamin as their sole source of 'vitamin B' is the general symmetric dermatitis. *This occurs especially on the backs of the forepaws, forearms and backs of the hind paws, the medial surface of the fore and hind legs, and the ears* It has also been the basis for its supposed identification with human pellagra (which has not been sufficiently corroborated clinically) In addition to this pellagrous condition, several authors take account of other less special symptoms soreness of the mouth, nose, and spectacle-like rings of inflammation around the eyes, a tendency for lids of one or both eyes to adhere together, with an accumulation of dried secretion on the margin of the lids, in some instances loss of fur, particularly on the neck, shoulders or back (saddle-like areas of baldness), small, dry, cream coloured scales or yellowish crusts over a large part of the body Occasionally these less specific symptoms may prevail and give quite a different aspect to the pathological appearance

The view has already been considered by J Goldberger that these two classes of dissimilar skin changes are to be ascribed to a deficiency not only of vitamin B_2 but also of another component of the vitamin B complex Hitherto no definite proof of this has been given.

In recent investigations, we have been able to fill this gap The result was an unexpected one We fed rats with an ordinary vitamin B-free diet (caseinogen A B. Glaxo 18 per cent, rice starch 68 per cent, butter fat 9 per cent, cod liver oil 1 per cent, salt mixture 4 per cent) supplemented by a vitamin B_1 preparation from yeast highly purified by the method of Windaus *et al.* (1 pigeon-unit = 8–12 γ) and with vitamin B_2 (lactoflavin 10 γ daily). In a large number of the animals we observed pellagra-like changes in the skin In order to avoid symptoms of B_4 deficiency (loss of co-ordination, ataxia, spastic gait) it appeared necessary to give a higher dose of the vitamin B_1 preparation. The appearance of pellagra-like symptoms was accelerated by the administration of 4–6 pigeon units, whereas when smaller doses were given the skin symptoms were not observed at all or else only in a very moderate degree[4]. When the B_2-free diet of A. Bourquin and H. C. Sherman[5] was used, the addition of B_1 and B_2 supplements produced pellagra-like skin changes The classical picture of the symmetrical pellagra-like dermatitis, with reddening and swelling of the fore and hind paws and ears as the specific characteristics of the condition, occurred particularly distinctly when egg-white (3–5 c.c. daily) was added to a vitamin B-free diet supplemented by vitamin B_1, or to the Bourquin-Sherman diet Administration of vitamin B_2 (lactoflavin) intensified the symptoms even more, and here it should be mentioned that egg-white is already known to be rich in vitamin B_2 (H. Chick and M. H Roscoe[6])

These effects were obtained with remarkable regularity and we must conclude from the results that the 'pellagra-like' dermatitis is not produced by a lack of vitamin B_2, as it is isolated in flavin pigment We are much more readily able to produce the pellagra-like dermatitis, unaccompanied by non-specific and uncharacteristic secondary symptoms, in the presence of B_1 (perhaps contaminated with B_4) and B_2. This pellagra-like dermatitis can be cured by the administration of the B_1+B_4 eluate from the charcoal adsorbate from yeast extract as prepared by the method of Kinnersley, O'Brien, Peters and Reader[7] This antidermatitis factor cannot be identical with B_4 for the following reasons (1) our animals show no signs of B_4 deficiency, (2) the skin lesions can be alleviated by alkaline autoclaved marmite, in which according to Reader the vitamin B_4 must have been destroyed One might rather identify it with the alkali stable factor *Y* of H Chick and A M Copping or the B_5 pigeon factor In order to avoid confusion, we have for the time being named this 'rat pellagra preventive factor' in its narrow sense vitamin B_6

By the administration of B_1+B_4 $(+B_6)$ or Peters's yeast eluate for 10–15 weeks, skin changes were certainly produced, but they were never pellagra-like, but 'unspecific' as above mentioned and mostly only trivial These skin changes can be cured by B_2 In this sense, B_2 is also a skin factor and it can be understood that egg-white, for example, which contains no B_6, can cure these 'non-specific' skin changes because it is rich in B_2 (cf Chick and Copping)

So we have been able to separate vitamin B_2, the antidermatitis factor, into two components—the real vitamin B_2 (flavin) and vitamin B_6 *

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* The vitamin B_1 was prepared by the I G Farbenindustrie, Elberfeld, Germany, and the lactoflavin was kindly prepared by my colleagues, R Kuhn and Th Wagner Jauregg (Heidelberg), at my request

[1] P György, R Kuhn and Th. Wagner-Jauregg, *Naturwiss*, 560; 1933 *Klin Wschr*, 1241, 1933 *Z physiol Chem*, 1934
[2] Public Health Rep Wash, 41, 1025, 1926
[3] *Biochem J*, 21, 698, 1927.
[4] cf M Kellog and W H Eddy, *Science*, 88, 609, Dec 29, 1933
[5] *J Amer Chem Soc*, 53, 3501; 1931
[6] *Biochem J*, 23, 498, 1929
[7] *Biochem J*, 27, 225, 1933

Effect of Mitogenetic Rays on Eggs of *Drosophila melanogaster*

THE different methods for the demonstration of Gurwitsch rays have in common that the technique is always subtle and requires much practice; Magrou alone has described a simple method while using the eggs of the sea-urchin, but these eggs are only obtainable in certain months of the year and in marine laboratories; so we have sought for a more convenient object and have found it in the eggs of *Drosophila melanogaster*.

We used strips of paper, with a layer of agar and ordinary treacle; after deposition of the eggs by the flies, we put the paper strips into Petri dishes and moistened them with water The source of our Gurwitsch rays was a culture three hours old of *Staphylococcus pyogenes aureus* in ordinary broth. The broth was put into test-tubes of fused silica closed by corks, and placed on the opened Petri dishes containing the paper strips with the eggs. The most suitable time for irradiation was found to be 20 minutes Afterwards the two Petri dishes (irradiated and control) were closed with their covers of glass, and kept under the same conditions. We counted the larvæ that were hatched each day and sometimes every couple of hours; so we could always choose an epoch, when only 20–60 per cent of the control eggs were hatched, while a much greater number of the irradiated eggs were hatched

The following results, which speak for themselves, were obtained from nine experiments

Controls			Irradiated Eggs				
No of eggs	No hatched	Per cent hatched	No of eggs	No hatched	Per cent hatched	Time of irradiation	Diff (per cent)
39	25	64	51	45	88	15–20 min	24 ± 10 6
81	15	18 6	72	30	41 7	15–20	23 1 ± 7 45
52	18	34 6	60	49	81 7	15–30	47 1 ± 8 1
304	210	69	312	300	96 1	20	27 1 ± 8 5
324	147	45 4	304	228	75	20	29 6 ± 3 7
344	255	74	327	323	98 4	20	24 4 ± 2 6
366	136	37	357	244	68	20	31 ± 3 5
118	79	67	117	98	83 5	20	16 5 ± 5 5
74	38	51 3	85	60	70 6	20	19 3 ± 7 7
1702	923	54 2 ± 1 2	1685	1377	81 7 ± 0 95		27 5 ± 1 54

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The Pectoral Fin of *Coelacanthus tingleyensis*

THE structure of the internal skeleton of *Coelacanthus tingleyensis*, Davis, was first described[1] and figured[2] by Wellburn as having six basal supports radiating out from the shoulder girdle in a manner similar to those in a pectoral fin described by Woodward[3] from the Talbragar Beds In view of the recent work of Stensiö[4] on the structure of this fin in the Triassic Coelacanth *Laugia groenlandica*, we have re-examined Wellburn's specimen, which is now in the Leeds City Museum (No D17), and found that the fin does not show the radials described by Wellburn. This we consider is important and worth putting on record, for it would have been difficult to reconcile the actinopterygian-like arrangement described by Wellburn with the archipterygial type of fin present in the later Triassic Coelacanths.

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[1] *Geol Mag*, dec iv, 8, 71, 1901
[2] *Proc York Geol and Polyt Soc*, 14, 483, 1902
[3] Mem Geol Survey of New South Wales. Pal. No. 9. 1895. P. 3 Pl II fig 1
[4] Med om Grønland, 83, 62, 1932

Research Items

Archæology of Hawaii. A survey of the archæology of Oahu based on field work in 1930 by Mr. J. Gilbert McAllister (*Bull.* 104, Bernice P. Bishop Museum, Honolulu) has been undertaken in order to place on record such evidence as remains of the people who were in Hawaii when it was first visited by European voyagers European culture and exotic vegetation introduced into the island are rapidly destroying the sites; but knowledge of them is still treasured by the older inhabitants Various types of remains are here recorded. The old Hawaiian places of worship fall into two groups, large communal places of worship, for which the term *heiau* is generally employed, and small shrines at which offerings were made The former are the most interesting remains now found on Oahu Of these there are 27, while on 19 other sites portions remain. In size they range from 50 ft × 40 ft. up to 570 ft × 170 ft. They may be classified into walled structures, terraced structures and walled and terraced structures. The sacrificial *heiau* was the highest type On it human sacrifices were offered, and it could be built only by a king It was essentially a war temple. The husbandry *heiau* was used chiefly to ensure the prosperity of the people. With few exceptions the *heiau* were built of natural basalt The smaller places of worship were fishing shrines, family shrines and road shrines, those functioning in connexion with fishing rites being by far the most important of these. The ceremony consisted in making an offering It was made by one individual who was regarded as the guardian of the shrine Several were sacred to certain fish only. Four shrines consisting of small enclosures were noted, but probably most shrines consisted of single stones The family shrine was an integral part of every household; while the road shrine was a place where offerings were made to some spirit

Ostracod Feeding Mechanisms. Prof H. G. Cannon has already given us valuable information on the feeding mechanism of various Crustacea and has evolved a very effective technique in studying them. A recent paper, "On the Feeding Mechanism of Certain Marine Ostracods" (*Trans Roy. Soc Edin*, 57, Part 3, No. 30; 1933), concerns *Asterope* and *Cypridina* and the comparison of their mouth parts. Also those of *Cytherella* are described. *Asterope* is a purely filtratory feeder with a perfect filter apparatus; no large particles are taken and there are no labral glands, the labrum being very small. *Cypridina* feeds both on large food masses and on minute detritus which it abstracts from the water in the same way as *Asterope*, but the labrum is large, with a labral gland the slimy secretion of which entangles the food particles, and there are biting jaws Prof. Cannon believes that the asteropids are probably derived from some detritus-eating cyprinids, *Asterope* being extremely specialised. *Cytherella* is a purely filtratory feeder, the mechanism being of a similar type to that of *Asterope*, but the processes are carried on by different limbs.

Plankton of the North Sea. Mr. R. S. Wimpenny in his paper "Variations in North Sea Plankton, 1923–24" (Ministry of Agriculture and Fisheries. Fishery Investigations, series 2, vol. 13, No. 3. 1933) studies the plankton of six stations running from Flamborough Head, east by north, to the "S.W. Patch" of the Dogger Bank. This is in accordance with the recommendations of the plankton section of the Conseil Permanent International pour l'Exploration de la Mer at Copenhagen in September 1932 "that the importance of the range of variation be kept in view". In addition, some work is included bearing on seasonal variation on the "Hydrographic Line" cruises across the whole North Sea in 1923 and the spring of 1924 The importance of the edges of marine banks for supporting a rich diatom flora is shown, especially the Dogger Bank, where there was more phytoplankton than on the Flamborough line towards the shore. Peridinians always followed diatoms, *Ceratium* being very abundant. It is pointed out that those organisms which store fat as food reserves are thus succeeded by those which store carbohydrates This has a notable physiological aspect. The distribution of *Calanus*, *Apherusa* and *Themisto* suggests their dispersion around the North Sea from west to east. The following recommendations are made. (1) a general investigation of the life-cycle of each important species individually, and its feeding habits over a wide area; and (2), a study of the direction and speed of currents in the area by direct comparison of current measurements and plankton

Parasites of Carrion-infesting Flies. Observations on the morphology and biology of some hymenopterous parasites affecting blow-flies of the genera *Lucilia* and *Calliphora* form the subject of a recent paper by Mr. A. C Evans (*Bull Entomol. Res*, 24, pt. 3). As regards the braconid *Aphaereta*, its behaviour in relation to its hosts suggests that the fore tarsi play an important function in egg-laying and possibly contain receptor organs of a tactile or other nature The eggs of *Aphaereta* increase their volume 2,900 times between the time they are laid and when they are ready to hatch. Nourishment for the rapidly growing embryo is stated to be obtained by its diffusion through the chorion of the egg As regards *Alysia manducator*, there is but little increase in the size of the developing egg. The modifications resulting from a gradual change from an ectoparasitic to an endoparasitic life, as revealed in the larvæ of the several genera studied, are discussed in some detail. In *Alysia* the egg can successfully develop when withdrawn from the body-cavity of its host, while the newly hatched larva bears a pair of open mesothoracic spiracles and closed rudiments of spiracles on the seven following segments. From these facts, and other structural features, such as the presence of a cocoon, the author concludes that the endoparasitism of *A. manducator* is a recent acquirement or, at any rate, has not reached the advanced condition displayed in other endoparasites of the same hosts. In a third parasite, *Habrobracon brevicornis*, which is an ectoparasite, the spiracles remain open throughout larval life, locomotory spines and protuberances are present and a well-developed cocoon is formed

Arizona Cacti. The first Biological Bulletin of the University of Arizona Bulletin (4, No. 3) contains an account of the Arizona cacti by W. P. Stockwell and L. Breazeale. It is a non-technical compilation based on Britton and Rose's standard work, primarily intended to facilitate identification and prefaced by a short illustrated account of the vegetative and floral parts of a cactus. A feature of the work is the large number of illustrations; line drawings of joints and spines accompany the keys to the genera and species, and photographs of most of the seventy-seven species described are included. Points of interest connected with the form and usage of the species are included in the generic and specific descriptions given in the body of the work: thus *Carnegiea gigantea* is recorded as reaching a height of forty feet and an age of 150–200 years.

A New Genus of Phycomycetes. Whilst investigating certain fungi which attack snapdragon plants, Mr. C. G. C. Chesters found a peculiar fungus which produced chlamydospores in abundance, and also thick-walled spores which were often bicellular ("A Phycomycete associated with a Diseased Condition of *Antirrhinum majus*", *Trans. Brit. Mycol. Soc.*, 18, part 3, 199–214, December 1933). The fungus produces spiny chlamydospores in the host plant and also on all the numerous kinds of culture media which have been used. The formation of the thick-walled spores is described, and shown to be roughly similar to the development of zygospores, though there are important differences. No thick-walled spore has yet been germinated, and it is supposed that the fungus represents an intermediate stage between Zygomycetes and other groups of the Phycomycetes. The organism cannot apparently be included in any existing genus, so the euphonious name of *Azygozygum chlamydosporum* nov. gen. et sp. has been suggested.

Origin of Apple Varieties. In a genetical investigation of cultivated apples, Messrs. Crane and Lawrence (*J. Genetics*, 28, No. 2) have obtained important results bearing on the production of new varieties. Many of the crosses between varieties produce few viable seeds and most of the resulting seedlings are lacking in vigour owing to aneuploid chromosome constitution. Among 50 varieties, varying degrees of self-incompatibility were present, but only two failed entirely on selfing. Certain varieties and crosses also produced albinotic seedlings. With this exception, intergrading variation was the rule as regards such fruit characters as skin and flesh colour, size, shape, flavour and time of ripening, indicating the presence of polymeric factors. It is known that many common varieties of apple are triploid, the remainder being diploid, none tetraploid. The n number of chromosomes is 17, while in most other Rosaceæ $n = 7$, or in certain genera 8 or 9. Various views of the origin of $n = 17$ from the lower numbers are held, based on the secondary pairing of the chromosomes and other evidence, but all are agreed that some of the chromosomes are present several times, thus giving a basis for polymeric factors and graded inheritance. Such well-known varieties as Baldwin, Blenheim, Gravenstein and Ribston have $3n = 51$ chromosomes. From Vavilov it appears that wild apples occur widely in Asia. He reports that in the Caucasus the fruits are small, while in Turkestan a great range of size and quality occurs, some wild trees bearing fruit of excellent flavour and large size.

Air Currents Around the Rock of Gibraltar. In *Geophysical Memoir* No. 59 of the Meteorological Office, J. H. Field and R. Warden describe "A Survey of the Air Currents in the Bay of Gibraltar, 1929–30", but the investigation, which was undertaken owing to accidents to aircraft in the lee of the Rock of Gibraltar, was confined to the disturbances set up by easterly winds, these being of the greatest practical importance to aviation. The work divides itself into two distinct sections; first, experiments with a model of the Rock on a scale of 1 : 5,000 in a wind tunnel at the National Physical Laboratory, and secondly the study on the spot of actual wind currents at different heights with the aid of pilot balloons and kites, in order to form an idea of the extent to which the system of currents observed in the wind tunnel corresponds with reality. The unusually large figure for the scale ratio model : actual (a ratio somewhere between 1/10 and 1/200 is usual in work of this kind) made this practical verification the more necessary, but it was found that on the whole the indications of the model were reliable in so far as they gave a correct picture of the directions of the different currents and of the types of permanent or temporary eddy set up. Great turbulence extended for fully two miles to the west of the Rock in easterly winds, from sea-level up to at least a height of 5,000 ft. The system of vortices included two that were large and permanent for a given wind direction, and with a shift of wind from due east there was generally a corresponding shift of the areas of danger, and at the same time changes in the permanent vortices. For the immediate purpose of the inquiry—the avoidance of further accidents—the most important item in the work is probably the map showing the positions of the danger areas for different wind directions, but there are many items of interest to meteorologists; for example, the conclusion that the obstruction caused by the Rock in a wind of only Beaufort force 6 caused vertical velocities of about twenty-five miles an hour for short periods. The conclusion was also reached that in such investigations the use of a kite balloon for a single day can give more information than many months of pilot-balloon work.

Action of β- and γ-rays on Rock Salt Crystals. When crystals of rock-salt (and many other substances) are exposed to β-rays, γ-rays or X-rays, they acquire a new spectral absorption band (giving a characteristic colour) and a photoelectric conductivity when illuminated by light frequencies within this band. Burbidge (*Proc. Camb. Phil. Soc.*, 30, Part 1) has made experiments on this effect. Using small exposures to the activating agent, he found that the photo current obtainable died away with time, so that in a few minutes he could collect all the charge that the crystal was capable of carrying. If the crystal is left in the dark, the 'activation' gradually decays, but in any event the number of electrons collected is only of the same order as the number of β-particles or γ-quanta absorbed. This is peculiar, since it is known that ultra-violet light of quantum energy 5 volts will cause activation and the β particles have, of course, energies of 10^5–10^6 volts. It is suggested that the activation is confined to comparatively rare centres such as foreign atoms or micro cracks. During the activation, a large number of electrons are disturbed from their normal levels to the lattice conduction levels, but except at such singular points, they rapidly revert to their original state. At the singular parts they revert to comparatively stable intermediate levels from which they can be raised by the absorption of blue-light quanta. Further work is contemplated—it would clearly be very interesting to determine the efficiency of activation for ultra-violet radiation of comparatively low quantum energy.

Thirteenth Annual Report of the Forestry Commissioners*

THE Forestry Commission is in its second decade For the work proposed for the decade it had been estimated that a sum of about 11¼ million pounds would be required, working receipts were estimated at £2,160,000, the net contribution from the Exchequer being £9,115,000 The chief works to be carried out were the afforestation of 353,000 acres and the establishment of 3,000 workers' holdings For the purposes in view it would be necessary to acquire each year 6,000 acres of plantable land and 2,500 acres of agricultural land These proposals were subject to a severe cut at the hands of the May Committee in the interests of economy (NATURE, Sept 17, 1932, p 427) As a result of subsequent discussions between the Commissioners and the Chancellor of the Exchequer, the latter undertook to provide annually for the next five years a sum of £450,000, this with working receipts giving the Commissioners about £600,000 annually for forestry operations

Changes of policy in Government departments other than that dealing with forestry, however admirable their main aims at retrenchment may be, often result, in the first instance, in unavoidable losses In the case of forestry, sudden fluctuations of policy, justified apparently by the necessities of the Exchequer, are particularly liable to lead to loss and waste. In the present case, where so large an amount of the work of the Forestry Commission is planting and the provision of the plants required annually for the estimated area to be afforested, a serious annual curtailment of the land to be planted up would of necessity be followed by a drastic decrease in the number of plants required for the purpose. This inevitable result was foreseen at the time the recommendations of the May Committee were accepted and at the subsequent discussion between the Commission and the Chancellor of the Exchequer. Questions asked in the House of Commons on the subject in July last appeared to show that the unavoidable outcome in this respect had not been appreciated The Report for 1932 thus alludes to this important matter, and merits putting on record

"It will be appreciated that the sudden change in the Commission's planting programme could not be made without waste The material losses are most apparent in respect of nursery plants. In view of all the facts it was decided to retain in the nursery only those surplus plants which were within the economic limit of age [four years old] and, further, did not necessitate additional expenditure in weeding, etc. There has thus been a destruction of surplus plants beginning in the nursery season 1932 and not yet at an end. When the readjustment has been completed it is estimated that the cost price of the plants involved will amount to approximately £50,000"

The net total area acquired in Great Britain to September 30, 1932, was 709,008 acres, of which 439,885 acres were classified at the time of acquisition as plantable Of the plantable area 265,275 acres (60 per cent) are situated in England and Wales and 174,610 acres (40 per cent) in Scotland The total area planted or sown during the year was 22,663 acres, of which 21,277 acres were placed under conifers and 1,386 acres under broad-leaved species. Included in the above are 522 acres reafforested in the former Crown woodlands and 182 acres replanted after damage by fire The 'Cost of Planting' still unfortunately remains at a high figure. It is stated that "The outlay per acre on labour and material on the areas planted between 1919 and 1932 was as follows. England and Wales, £9 3*s* 0*d*.; Scotland, £9 15*s* 1*d*; Great Britain, £9 7*s* 3*d* These figures cover the cost of preparation of ground, drainage, fencing, plants, planting, replacement of failures and weeding but do not include expenditure on forest protection, overhead charges and supervision." Perhaps 'Cost of Formation' would be a better term than 'Cost of Planting' for operations which cover a great deal more than the mere 'planting'

The total addition to the forest area of Great Britain during the year was 16,927 acres In forming plantations and beating-up previous years' plantations 51,600,000 trees were used, of which 39 per cent were Norway and Sitka spruces; 32 per cent Scots and Corsican pines, 14 per cent European and Japanese larches, and 3 per cent Douglas fir An area of 242 acres of existing woods was underplanted, necessitating the use of 217,000 plants

Grants to private individuals and local authorities for planting and scrub-clearing (on the basis of £2 per acre for planted conifers and £4 per acre for approved hardwoods to be maintained thereafter as forest crops, and £1 per acre for clearance of scrub on areas of not less than 20 acres) amounted to £11,710, advances in respect of a proceeds-sharing scheme to £1,483 and overhead and supervisory charges to £3,148

In connexion with afforestation schemes generally, many countries are now interested in the question of the annual production of seed of a varying number of important timber trees, both conifer and hardwoods, the failure of a seed year of an important species becoming of almost world-wide importance. In this matter the British Empire has an interesting record, for it is many years since interchanges or gifts of forest tree seeds were started between Australia, India and South Africa, to mention three countries only. The competition in modern times for the seed of certain species has become greater and this applies more especially to some of the temperate conifers such as Sitka spruce, Japanese larch and so forth With this competition the prices of seed of certain species have risen considerably It is pleasant to recognise that inter-Empire and international courtesy results in handsome gifts of seed being made by one country to another On this interesting matter the report has the following: "The only seed which had to be imported from North America was Sitka spruce from the Queen Charlotte Islands · Japanese larch could not be obtained from Japan. Norway spruce and European larch were in abundant supply from the Continent, but only a moderate quantity of Corsican pine was procurable. As regards Great Britain, Scots pine seed was plentiful, but requirements of European larch could not be met; seeds of hardwoods with the exception of ash were again scarce" The Commissioners acknowledge their thanks for gifts of seed from the forest authorities of Bulgaria, France, Greece and Portugal

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* Forestry Commission Thirteenth Annual Report of the Forestry Commissioners for the year ending Sept 30, 1932. Pp 43 (London H M Stationery Office) 9*d* net

Acquisitions of land on a reduced scale were sanctioned, as also the inauguration of a certain number of forest workers' holdings Acquisitions of land during the year amounted to 81,933 acres, of which 46,437 acres were classified as plantable, whilst 115 holdings were completed during the year, the total number now amounting to 1,156 at an average cost per holding of £499

The balance in the Forestry Fund at the commencement of the forest year was £446,432 Receipts from Parliamentary votes (£447,000) and forestry operations (£151,466) amounted to £598,466 Payments amounted to £761,220, so that the balance in the Fund at the end of the year was £283,678

During the year the Commission lost Lord Lovat, its first chairman, and Mr H A Pritchard, assistant commissioner for England and Wales This thirteenth annual report may be regarded as a most fitting memorial to Lord Lovat, to whose remarkable energy and enthusiasm, supported by a strong body of commissioners and a keen staff, the present position of forestry in Great Britain must be ascribed

Racial Distributions and Archæology

IN a lecture delivered in January last year at the John Rylands Library, Manchester, and recently available (*Bull* John Rylands Library, vol 17, No 2 Separates, Manchester University Press, 1s net) Prof H J. Fleure puts forward a tentative correlation of the evidence of archæology, human palæontology and ethnology Prof Fleure aims at showing that certain phases of culture may be associated with certain physical types of man in the past, and that, subject to the reservation that modification of culture may have taken place from outside, this association still holds good in modern representatives of, or approximations to, these ancient physical types He also suggests the possible lines along which races have attained their present distribution

Homo sapiens and *Homo neanderthalensis* clearly were differentiated at an early date The former is known from East Africa, the latter essentially belongs to Eurasia In the Old Stone Age, the flake implement is associated generally with Neanderthal man, while the finer technique of the core implements points to it being the work of *Homo sapiens* The distribution of the core implement suggests that it may have arisen in Africa or south west Asia and spread, on one hand to India, and on the other to western Europe

The rise of hunting differentiates the work of the men from that of the women, the latter continuing to be food gatherers Among modern food gatherers and hunters are the pygmy peoples of Africa and south east Asia Their breadth of head is possibly an ancestral trait derived from extinct types of man, such as Neanderthal man, whose heads incline to brachycephaly, if the torus is ignored Unfortunately, no ancient skeletons of pygmies are known On the other hand, a majority of the representatives of early *Homo sapiens* have long heads and most of the characters of the one of the two types into which these can be differentiated, are found among primitive hunter and collector groups, such as the jungle tribes of India, the Veddah of Ceylon and the Australian. The Bushmen and the extinct Tasmanian also include a good proportion of extreme long heads, as also do the Eskimo. These two groups may represent two early drifts of man, pushed to the farthest corners of the earth, while the pygmies took refuge in the equatorial forests

There are numerous groups in which most have moderately long heads, while a few have extremely long heads These are common in Africa, around the western Mediterranean, in North Africa and a related type is found in the Deccan of India, while much the same may be said of large groups in the East Indies. All are essentially herdsmen or cultivators African groups show that hunter men acquired cultivator women The herdsman grew from the hunter Herding made men more predominant than ever and increased their pride in their breed Cultivation first arose in north-east Africa and south west Asia, perhaps in India as well, and there may have been a primary spread thence to the west and south east The spread to the south in Africa encountered difficulties of climate and the cultivator remained essentially a woman It is, therefore, probable that much of the stock whence springs the pygmies was handed down in Africa, while in south-east Asia, there are traces, if rare, of this early stock, and the inhabitants of Papua have kinky hair It seems useful, therefore, to think of a gradation with an increase in importance of the older types and style of life as one goes south in Africa, or through south-east Asia to Papua, while the absence of cultivators in Australia and Tasmania points to the isolation of these two areas before the arrival of cultivators in Papua

North of this area of culture and drift lies the mountain mass of Tibet with its westward extensions North of this the ways would be open only after the last glaciation. The north-eastward drifts through Asia, continuing into America, belong to a Tardenoisian or late Capsian phase

In this connexion the rise and spread of broad-headed man must be considered The main area of distribution is the mountain zones of Asia, Anatolia and Central Europe Tentatively it may be suggested that the type came into existence in south-west Asia, in or near the Anatolian peninsula Knowledge of ancient skulls is still insufficient to say when these broadheads moved into Central Europe, but there are broadheads from an epipalæolithic station at Ofnet, and from the beginning of the Bronze Age there is a peasantry in Central Europe Some of the peoples of the Pamirs are broad-headed and in other respects like the people of Central Europe. It is difficult not to suggest a common intermediate origin for the two In Anatolia and the western part of the Balkan peninsula there is a very broad-headed type with very straight occiput This may be a specialisation which has superseded the older form

Farther east and associated with the high plateau of the Gobi is a different intensification of broad-headedness, the most marked form being that with the face flattened, oblique eyes, yellow-brown skin and lank hair.

It is possible that these broad-headed types spread in the early days of the development of cultivation. There was evidently an important spread of population about the middle of the third millennium B.C. in and around the great steppe, which reached north China and may be responsible for some of the drifts to America.

So far as the steppes of western Asia and southern Russia are concerned, the broad-headed type was not the earliest in the population The graves of the third millennium yield a majority of extreme long heads, differing from the hunter and collector people surviving farther south. This type spread into Europe from the early Bronze Age onwards Later in the Bronze Age came a period of warmth and drought which leaves the steppe poor in remains and probably accounts for the small extent to which inter-tropical Africa was influenced by Bronze Age movements. The Bronze Age movements distributed skilled craftsmen with a high grade of organisation far and wide; while as regards the steppe the movements had acquired the driving power of the acquisition of the horse Hence their movements were turned towards Iran and India, in directions in which conditions were suitable, rather than to the north-east. These peoples are generally credited with being the authors of the Aryan languages Their relation to the people of the Old Stone Age is not clear.

There remains a long-headed element, or rather on the long-headed side of medium, found in western Europe, as for example in Britain and eastern Asia, notably in China. There are indications of a spread of early agriculturists through south-eastern Asia to north China, which included moderately long-headed elements as well as broad-heads; and this element may also have been included in a similar migration to western Europe, but lack of data precludes dating.

Industry and the Research Associations

ON March 22, the Department of Scientific and Industrial Research convened an important conference at the Institution of Civil Engineers, at which Lord Rutherford presided, and more than one hundred representatives of the twenty-one research associations formed under the auspices of the Department were present The object was to provide an opportunity for frank discussion with officers of the Department and members of its Advisory Council on the present position of the research association movement and its future

On the eve of the conference, Sir Kenneth Lee, who is a member of the Advisory Council closely identified with the work of the research associations, and whose firm belief in industrial research is well known, entertained the representatives to dinner at the Dorchester Hotel. Mr. Runciman represented the Government and many prominent men in industry, finance and in the Civil Service were present Among the speakers were Mr. Runciman, Lord Rutherford and the Right Hon. Reginald McKenna. In the course of his remarks, Mr. Runciman read a statement from the Lord President of the Council, in which Mr Baldwin said that those present no doubt shared the opinion of the Advisory Council that the present scale of operations of the research associations is totally inadequate if they are to serve their full purpose He looked forward, with confidence, to industrialists improving matters in that respect, especially now that the prospects of trade are more promising. If they do so, Mr. Baldwin's message continued, they can rely on the Government on its side being prepared to play some part in the forward movement and to help in extending the scale of operations.

The views expressed at the conference left no doubt that the Advisory Council of the Department is right in believing that the time is ripe for a great development in the research association movement. The associations have already made a deep impression on British industry, not only in producing practical results of great monetary value, but also in bringing about a more sympathetic attitude towards the usefulness of scientifically trained men in the works. Several speakers emphasised the paramount duty of research associations of carrying out long-range investigations essential to widening the boundaries of knowledge Reference was made to the benefits conferred on the consumer by the improvement in products as regards utility and price and to the raising of the standard of living resulting therefrom, and for this reason it was urged that a continuation of a substantial contribution from Government sources is fully justified Attention was also directed to the importance of achieving stability of finance for the research associations as a means of securing the best work from those employed by them, of ensuring that the best scientific brains are available for that purpose and of making possible the planning of long-distance programmes.

At the conclusion of the proceedings, Lord Rutherford referred to the statement made by Mr Runciman the previous night on behalf of the Lord President as to the willingness of the Government to afford increased financial help, and urged that as a next step the councils of the research associations should consider the scale of work required to meet the needs of their particular industries and submit proposals for the consideration of the Department, in order to bring about at the earliest possible date a very different scale of operations

University and Educational Intelligence

CAMBRIDGE.—The following appointments have been made: Dr. W. A. H. Rushton, of Pembroke College, to be University lecturer in physiology. Mr O A Trowell, of St. John's College, to be University demonstrator in physiology and Dr H. N. Green to be University demonstrator in pathology

LEEDS.—The following appointments have recently been made: Dr Douglas H. Collins, to be research fellow in rheumatism under the scheme of co-operation between the University of Leeds and the Harrogate Royal Bath Hospital, for the institution of research into the cause and cure of chronic rheumatism and allied conditions; Dr. W A. Bain, to be lecturer in physiology

THE Educational Advisory Board of the British Social Hygiene Council is proposing to form a permanent central exhibit of biological teaching material and apparatus. In view of the increasing demand for including biology in school curricula, such an exhibit should prove useful to teachers The Board is therefore seeking suggestions in connexion with all forms of biological material. Further information concerning the proposal and a list of suggested headings under which information is sought can be obtained from Mr. Percy F. Lee, Education Officer, Educational Advisory Board, British Social Hygiene Council, Carteret House, Carteret Street, London, S.W.1

Science News a Century Ago

A Charter for the University of London

At a Court of the Common Council of the City of London held on April 3, 1834, the Lord Mayor stated that he had received a request, numerously signed, calling on him to convene a special meeting to consider the propriety of presenting an address to His Majesty praying that a charter might be granted to the University of London. A supporter stated his belief that the King and Ministry agreed in the desirability of granting the charter, and that the signature of His Majesty would have been put to the charter had not a petition against it been presented by the University of Oxford. It was urged against the proposition that Oxford, Cambridge, and other colleges never had the power of conferring degrees until they had gained a high reputation for ecclesiastical and scientific learning. The speaker looked upon the University of London as a mere joint stock company, and stated that he held in his hand a £100 share of the University of London, which had been sold that very morning for £23. He proceeded to ask how the Corporation could be justified in going to the King for a charter for a concern the shares of which were sold for £23 apiece. The motion to present an address to His Majesty in favour of granting a charter to the University of London was carried without a division.

Paris and London Geographical Societies

The Paris Geographical Society was founded in 1821, that of London in 1830. From the time of institution of the latter, the two bodies were on most friendly terms, and exchanges of courtesies were frequent between the respective officers.

The French society was itself considerably assisted in its early years through the co-operation of the reigning house. On January 1, 1834, the president, M. le duc Decazes, with many members, waited upon the King and Queen at the Palace of the Tuileries, and were received in audience for an hour and a half. The heir to the throne, the Duke of Orleans, was also present, and various State functionaries. In an address to the King, the president alluded to the interest of the Duke of Orleans in the Society. The King in his reply confirmed his own good wishes and desire to secure for France the honour of geographical discovery. An address to the Queen followed.

On April 4, 1834, at a general assembly of the Society, it was announced that the Duke of Orleans had offered a prize of 2,000 francs to the navigator or traveller whose geographical observations and results should be useful to agriculture, or in the industrial arts, in the course of 1834 and 1835. At this assembly, also, the award of a gold medal was decreed to Capt. John Ross for his recent discoveries and additions to geographical knowledge. (*Bull. Soc. de Géog. Paris*, ser. 2, vol. i.)

Surrey Zoological Gardens

The Surrey Zoological Gardens on the south side of the Thames in London were opened in 1831 by Edward Cross, who had previously had a menagerie at Exeter. On April 5, 1834, the *Times* announced that "a most important addition has just been made to the already valuable collections in these gardens, in the acquisition of a fine young rhinoceros, the only one of the species which has been in this country for the last 20 years. . . The great value attached to the possession of a living specimen of this animal, and the difficulty in procuring one may be inferred from the fact that the cost of the present, from the time it was taken in the Birman Empire, and the charge of its food and conveyance to England have exceeded 1000£ though it is yet little more than a year and a half old." After describing the animal, its food and its habits, the *Times* said. "The present specimen, owing to its youth, is as we have already stated, very harmless, and will follow in a fawning manner those who feed it, yet we understand that as it approaches to mature age its native fierceness will break out and will not tolerate the familiar approach of man, nor at times can its keeper enter its den without considerable danger. The last rhinoceros in this country was so fierce that it could not be exhibited until it was secured in its den by very heavy chains."

Death of Baron de Lesseps

On April 6, 1834, Jean-Baptiste-Barthélemi, Baron de Lesseps, the traveller and diplomatist, died suddenly at Lisbon at the age of sixty-eight years. For many years he had represented France, first in Russia and then in Portugal, and had held a post in Moscow previous to the disaster of 1812. He was born at Cette on January 27, 1766, and in 1785, when La Pérouse was fitting out the frigates *Boussole* and *Astrolabe* for an expedition to the Pacific, de Lesseps was appointed to accompany him as interpreter. The ships left Brest on August 1, 1785, doubled Cape Horn, visited the shores of California and in January 1787 reached Macao. Thence they proceeded to the coasts of Tartary and Kamtschatka, and at Avatska de Lesseps was sent home overland with the journals of the voyage, the journey across Siberia and Russia taking about a year. In December 1787, La Pérouse, leaving the north, called at the Friendly Islands and in January 1788 sent home from Botany Bay his last letter. Thirty-eight years later the remains of his ships were found by an English captain in the Queen Charlotte Islands. In 1790 de Lesseps published a journal of his journey from Kamtschatka, and in 1831 enriched with notes an edition of the "Voyage" of La Pérouse.

Mrs. Somerville Honoured

In 1831 Mrs Somerville had published her "Mechanism of the Heavens" and in the beginning of 1834 her "Connexion of the Physical Sciences". These works gave her a place among the most eminent women of science of all time. She was honoured by various scientific societies and on April 6, 1834, Mrs Marcet wrote to her from Geneva: "I am desired by Professor Prevost to inform you that you were elected an honorary member of the Société de Physique et d'Histoire Naturelle de Genève on the 3rd April, and that a diploma will be forwarded to you by the earliest opportunity. After all the honours you have received, this little feather is hardly worthy of waving in your plume, but I am glad that Geneva should know how to appreciate your merit. You receive great honours, my dear friend, but that which you confer on our sex is still greater, for with talents and acquirements of masculine magnitude you unite the most sensitive and retiring modesty of the female sex; indeed, I know not any woman, perhaps I might say any human being, who would support so much applause without feeling the weakness of vanity. Forgive me for allowing my pen to run away with this undisguised praise, it looks so much like compliment, but I assure you it comes straight from the heart, and you *must* know that it is fully deserved." Mrs Marcet was the author of "Conversations on Chemistry", which Faraday said "gave me my foundation in that science".

Societies and Academies

London

Institute of Metals (Annual General Meeting), March 8. H A Sloman Alloys of silver and beryllium. The constitution of the whole range of alloys in the silver-beryllium system has been redetermined by thermal and micrographic analyses Modifications and amplifications of Oesterheld's original constitutional diagram are proposed A description is given of new tarnish-resisting silver alloys obtained by the addition to silver and to some 'standard' silvers of very small quantities of beryllium C E Phillips and J. D Grogan · Transverse tests of sand-cast aluminium alloy bars The transverse test in the measurement of the ductility of alloys of low elongation does not yield information concerning ductility which is not obtained equally readily from the tensile test when a high degree of accuracy of measurement is available D Hanson and E G West Constitution of copper-iron silicon alloys The solubility of iron in copper is decreased by the presence of silicon Over the greater portion of the range of compositions examined, iron exists in the alloys as such, its solubility in the solid state decreases rapidly with fall of temperature and becomes very small below 700° C Within certain ranges of composition, iron and silicon combine to form another constituent, probably FeSi, which forms a series of alloys with the *a* solid solution FeSi also appears to form systems of alloys with the alpha, beta, gamma, delta and epsilon constituents of the copper silicon series The shape of the liquidus and solidus curves has been determined R Taylor Transformations in the copper-palladium alloys The determination of the electrical resistance-temperature curves has been carried out with a much slower change of temperature than had previously been used The occurrence of two transformations at 10–30 atomic per cent and 35–50 atomic per cent., respectively, and associated with different types of electrical resistance curve, has been confirmed Owen W. Ellis The malleability of nickel and of monel metal A discussion of the effect of annealing temperature on the hardness of two rods, ½ in and 1 in in diameter, respectively, of cold-drawn nickel, which were the subject of malleability tests at temperatures varying from 250° to 1,100° C The relationship between energy of blow and percentage reduction in height of normal ½-in. samples is demonstrated, as is the influence of the initial hardness of the same material on its resistance to deformation at 750° C John L Haughton and J M. Payne: Alloys of magnesium research. (1) The constitution of the magnesium-rich alloys of magnesium and nickel The constitution of magnesium alloys containing up to 50 per cent nickel has been studied by thermal and microscopic methods. Magnesium forms a eutectic with the compound Mg_2Ni at a temperature of 507° C. and a composition of 23 5 per cent nickel. The solubility of nickel in solid magnesium is less than 0 1 per cent

Royal Meteorological Society, Feb 21 Chang-Wang Tu China rainfall and world weather Walker's shorter method has been used for the calculation of the correlation coefficients and his criteria have been applied for testing the reliability of the coefficients Four fairly homogeneous regions have been chosen and the rainfall of each region is correlated with the pressure, temperature and rainfall of different seasons of various important stations of the world Increased circulation of the southern oscillation is generally responsible for the heavy rainfall of the rainy season in China. The total correlation coefficients obtained from the equations for the North China coast, Yangtze Delta, Yangtze Valley and south-east China coast are respectively 0 78, 0 62, 0 68 and 0 68 C. E P Brooks The variation of the annual frequency of thunderstorms in relation to sunspots. Annual frequencies of thunderstorms are formed for 22 groups of stations in all parts of the world, over periods up to 66 years, and are compared with the annual sunspot numbers When sunspots are numerous, thunderstorms are more frequent than usual in high northern latitudes and in the tropics, but in temperate latitudes the relation, if any, is small The 11½ year 'thunderstorm cycle' is then compared with the sunspot cycle, and the two are found to run parallel in Sweden and Siberia, but in maritime tropical areas the thunderstorm cycle lags about five months behind the sunspot cycle Over the earth as a whole, the frequency of thunderstorms at sunspot maximum averages about 22 per cent greater than the frequency at sunspot minimum

Edinburgh

Royal Society of Edinburgh, February 5. R A. Fleming: The psychology of crime and criminals, with special reference to measures for reformation The importance of mental defect, of the evil effects of newspaper and other accounts of crimes, and of the influence of detective stories in cinema and theatre were stressed The great value of Borstal training, provided there was careful grading of inmates, was emphasised and its extension to cases outside the terms of the existing Act was urged Freud's preconscious and unconscious theories which presuppose a dynamic energy, attached to the thoughts in both, striving for expression in the conscious are accepted, although the present methods of psycho-analysis which take for granted the necessity of unearthing all the sexual thoughts of the analysand, a procedure harmful for patient and psycho-analyst alike, are deprecated.

Paris

Academy of Sciences, February 5 (*C.R*, 198, 513–624) Jules Drach. Systems of partial differential equations with two variables reducible to a Laplace linear system Gabriel Bertrand and P Serbescu: The toxicity of aluminium according to its mode of entrance to the system. Continuing their experiments on the alleged poisonous action of aluminium derived from cooking utensils, the authors describe experiments on rabbits proving that when the metal is introduced through the stomach its toxicity is only one fourth of that when introduced by injection The view that aluminium introduced into food from cooking vessels is less poisonous than other metals such as copper and nickel introduced into food in the same way is confirmed J. Haag The decomposition of a nucleus into canonical nuclei Louis Roy The separating power [of telescopes] for two equal components. E Mathias. The storm of June 1, 1933, at Hanoï (Tonkin). J Dieudonné The maximum modulus of the zeros of a polynomial. Serge Tchounikhin The problem of the two classes of a finite group Bertrand Gambier Tetrahedra inscribed in a skew cubic and circumscribed with a developable of class 3 or a quadric J Delsarte · The application of the theory of mean periodic functions to the resolution of certain integral equations J Avanessoff Inequalities concerning the movements of revolution of a viscous fluid Caïus Jacob The problem of local unicity concerning the flow of heavy liquids Tchang Te Lou A new mode of ignition in the internal combustion motor The action of the high temperature of a disruptive discharge is not always indispensable for ignition, the silent discharge (*effluve*) is equally efficacious Jean Mascart The light of shooting stars Discussion of the mechanical and electrical theories regarding the production of light by meteorites the author considers the mechanical theory best accords with the known facts Ch Fabry · Remarks on the preceding communication While it is clear that the greater part of the light from a shooting star and the whole of that from its luminous trail is due to the luminosity of a gas, the mechanism of this emission is not clear L Goldstein. 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Royer The experimental study of the modification of the facies of crystals which grow in a solution containing certain foreign substances H Derville · The dome-shaped ridge of the Cambrian limestones of the region of Carteret (Manche) J. Bondon, L Clariond and L Neltner A new section of the Djebel Sarro (Saharan Morocco) Emm de Martonne. The *areique* diagonal of South America Paul Chauchard The proportion of dissolved oxygen in the waters of the estuary of the Seine F M. Bergounioux The group of pleurodire Chelonians in the course of geological time L Joleaud Subfossil vertebrates of Azaoua (Niger Colony) Mlle R Le Blanc. The reproduction of *Chætoceros pseudocurvisetum* P Laviaille and P Jaeger Floral polymorphism Gynomonœcia and gynodiœcia in *Knautia arvensis*. Mlle Bouges Some results of embryonic over- and under-feeding in oats Maurice Piettre The ripening of wheat grains The influence of some physicochemical phenomena. Mme L Nouvel Regenerating power in shrimps The relations with the casting of the shell and the existence of a critical threshold of differentiation of the regenerate M Paić and P Haber The action of the infra red, visible and ultra-violet rays on hæmolytic alexin (complement) and the absorption spectrum of guinea pig serum H Bierry and B Gouzon Proof of the presence of protoporphyrin of the blood by the fluorescence of its stannous complex In the action of stannous chloride on hæmatin and on hæmoglobin, a complex is formed which by its fluorescence spectrum can be identified with certainty as the stannous derivative of protoporphyrin N Kobozieff The mortality of mice with and without tails Statistics of abortive embryos René Legroux and Gaston Ramon The properties of the tetanus toxin made hypertoxic (hypertoxin) By the action of acids the toxic power of tetanotoxin can be increased thirty to eighty times S Nicolau and Mme. L Kopciowska The transformation of the fixed rabic virus into the common virus

Washington, D C

National Academy of Sciences (*Proc*, 19, 991–1058, Dec 15, 1933) L Harris, W Jost and R. W B Pearse Separation of hydrogen isotopes by diffusion through palladium Hydrogen, produced by passing steam from 'electrolysed water' containing 1 part in 1,000 of heavy isotope over heated iron, was passed through an electrically heated palladium tube The gas was enriched in the heavier isotope 5–8 times when the pressure was reduced from 750 mm to 39 mm, and a further 1 5 times when it was reduced to 8 mm. Thus a ten-fold increase in concentration is produced at one stage The method is not considered as likely to compete with the electrolytic method, except in special circumstances. Theoretically it suggests that diffusion of hydrogen through palladium is an atomic process and that there is an activation factor operating in favour of the heavy isotope Harlow Shapley and Jenka Mohr: Summary of a variable star survey in an external galaxy. A survey of Cepheid variable stars in the Large Magellanic Cloud As a whole, about 1 5 per cent of the supergiants between absolute magnitudes − 1 and − 4 are Cepheid variables. The most numerous periods are 2–3 days, and no important correlation exists between amplitude of variation and luminosity or period The diameter of the Cloud is about twelve degrees and its linear diameter not less than 15 000 light years HENRY NORRIS RUSSELL and DONALD H MENZEL The terrestrial abundance of the permanent gases Although nitrogen is one of the most abundant elements in stars and nebulæ on the earth it forms 0 02 per cent only even of the superficial material A theoretical discussion leads to the view that the so called permanent gases were mainly lost by escape into space within a short time of the birth of the earth as matter ejected from considerable depths in the sun HARLOW SHAPLEY On the linear diameters of 125 large galaxies Nothing comparable in size to our galaxy has been found (diameter 30 kiloparsecs) The average galaxy is a little less than 2 kiloparsecs in diameter the Large Magellanic Cloud is comparable with the mean of the 125 largest systems in 25 selected groups New values are derived for distances and mean density of matter in these groups W E CASTLE and HANS NACHTSHEIM Linkage interrelations of three genes for rex (short) coat in the rabbit Three races of these rabbits with abnormally short soft and plush like hair and curly whiskers have arisen in recent years by a recessive mutation in a different gene The genes responsible for two of the mutations are in the same chromosome (10–12 per cent crossing over) but the other is in a different chromosome These races may become important commercially for their pelts W E CASTLE The gene theory in relation to blending inheritance Generally speaking alternative characters (gene determined) characterise individuals blending characters are more fundamental and characterise species genera and families The cytoplasm of the egg affords a mechanism (for example the organiser of the amphibian egg) for the transmission of such blending characters though genes borne in chromosomes may modify them The present assumption that they are determined indirectly by genes is unproved M DEMEREC The effect of X ray dosage on sterility and number of lethals in *Drosophila melanogaster* Working under standardised conditions induced sterility and frequency of induced lethals are approximately proportional to dosage HARRY H LAUGHLIN The specific formula of heredity MARCUS M RHOADES (1) A cytogenetical study of a reciprocal translocation in *Zea* (2) A secondary trisome in maize G H PARKER The colour changes of elasmobranch fishes Two skates indistinguishable in colour became lighter and darker respectively when placed in a white and a black tank Changing the fish over reversed the changes one assuming a pinkish hue Two to twelve hours was required for the changes EDWIN B WILSON On overlap PAUL S EPSTEIN On the temperature dependence of ferro magnetic saturation The theory of ferro magnetism deduced by the author in 1932 fits very well data published by Allen and Constant which lead to the rule that the ratio of saturation intensity at any temperature to that at the absolute zero plotted against the ratio of temperature to Curie point for all ferro magnetic crystals of the cubic system gives one universal curve J L WALSH A duality in interpolation to analytic functions by rational functions G A MILLER Groups involving a small number of squares F J MURRAY A theory for * operators analogous to the theory of reducibility for self adjoint transformations in Hilbert space

Forthcoming Events

Friday, April 6

SOCIETY OF CHEMICAL INDUSTRY (CHEMICAL ENGINEERING GROUP)—at Leeds Joint meeting with the Yorkshire Section and the Food Group Conference on Air Conditioning with special reference to the Food Industries Papers by Dr Ezer Griffiths Dr M C Marsh and Dr L H Lampitt

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NINTH INTERNATIONAL CONGRESS OF PURE AND APPLIED CHEMISTRY April 5 11 to be held at Madrid Prof O Fernández president

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Official Publications Received

GREAT BRITAIN AND IRELAND

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1504 (T V C 64) Torsional Resonance Characteristics of a Twelve Cylinder Vee Aero Engine By B C Carter and N S Muir Pp 39+38 plates 3s net. No 1554 (Strut 91 97 and 146) Buckling of Thin Plates in Compression By H L Cox Pp 21+8 plates 1s 3d net No 1556 (T 3374) Pitching Moment due to Rotation in Pitch By Dr A S Halliday L W Bryant and C H Burge Pp 27+20 plates 1s 9d net No 1558 (I C E 946) Tests of a Roots Type Aircraft Engine Supercharger By the Staff of the Engine Experimental Dept R A E Pp 23+16 plates 1s 9d net (London H M Stationery Office)

Researches published from the Wards and Laboratories of the London Hospital during 1933 31 Papers (London H K Lewis and Co Ltd) 7s 6d net

University of London University College Annual Report, February 1933–February 1934 Pp ii+156 (London Taylor and Francis)

Committee of the Privy Council for Medical Research Report of the Medical Research Council for the Year 1932 1933 (Cmd 4503) Pp 161 (London H M Stationery Office) 2s 6d net

Department of Scientific and Industrial Research Index to the Literature of Food Investigation Vol 5 No 1 March 1933 No 2 September 1933 Compiled by Agnes Elisabeth Glennie Pp viii+283 (London H M Stationery Office) 5s net

OTHER COUNTRIES

Carnegie Institution of Washington Year Book No 32 July 1 1932—June 30, 1933 with Administrative Reports through December 15 1933 Pp xx+388 (Washington D C Carnegie Institution)

U S Department of Agriculture Circular No 307 Control of Aphids on Alfalfa in the Antelope Valley Calif By R A Blanchard Pp 7 (Washington D C Government Printing Office) 5 cents

Department of Agriculture Straits Settlements and Federated Malay States Economic Series, No 4 Bark Consumption and Bark Reserves on Small Rubber Holdings in Malaya By H D Meads Pp iii+50+9 plates (Kuala Lumpur) 50 cents

Smithsonian Miscellaneous Collections Vol 91 Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep No 3 A New Crab of the Genus Cyclodorippe By Mary J Rathbun (Publication 3230) Pp ii+1+1 plate No 4 Two New Crinoids By Austin H Clark (Publication 3231) Pp ii+5+2 plates No 5 A New Nematode of the Genus Diplotriæna from a Hispaniolan Woodpecker By Everett E Wehr (Publication 3232.) Pp ii+3 No 6 New Trematode Parasites of Birds By Emmett W Price (Publication 3233) Pp ii+6+1 plate No 7 New Digenetic Trematodes from Marine Fishes By Emmett W Price (Publication 3234) Pp ii+8+1 plate (Washington D C Smithsonian Institution)

Memoirs of the Geological Survey of India Palæontologia Indica New Series Vol 9 Memoir No 2 Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch) Part 6 By Dr L F Spath Pp viii+659–945+plates 125–130 18 8 rupees 22s New Series Vol 22 Memoir No 1 Echinoidea from the Persian Gulf By E L G Clegg Pp ii+35+3 plates 2.8 rupees 4s 6d (Calcutta Geological Survey)

Kungl Svenska Vetenskapsakademiens Handlingar Tredje Serien Band 12 No 6 The Structure of certain Fossil Spore-Bearing Organs believed to belong to Pteridosperms By T G Halle Pp 103+15 plates Tredje Serien Band 13 No 1 Meteorologische Turbulenzuntersuchungen I Von Hilding Köhler Pp 54 (Stockholm Almqvist und Wiksells Boktryckeri A B)

Ochrona Przyrody Organ Państwowej Rady Ochrony Przyrody Rocznik 13 Pp iv+207+3 plates Państwowa Rada Ochrony Przyrody No 35 Sprawozdanie z Działalności Państwowej Rady Ochrony Przyrody w Roku 1933 Napisał Prof Dr Władysław Szafer Pp 26 (Kraków Państwowej Rady Ochrony Przyrody)

Polska Akademja Umiejętności Prace Rolniczo-Leśne, Nr 7 Badania nad Glebami Górskiemi (Researches on Mountain Soils) By Tadeusz Wąsowicz. Pp 47 (Kraków Polskiej Akademji Umiejętności)

Union of South Africa Department of Mines Geological Survey The Geology of Capetown and adjoining Country an Explanation of Sheet No 247 (Capetown) By Dr S H Haughton with a Chapter on Underground Water Resources by H F Frommurze. Pp 90+2 plates (Pretoria Government Printer) 5s (including Map)

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Discovery and Invention

THE importance of scientific research in the modern State no less than in industry encourages discussions from time to time as to the mechanism of discovery and the best means of encouraging it Dr Lampitt for example in a recent address on fundamental problems of the food industry stressed the importance even in industrial research of a true spirit of inquiry the lack of which was liable to lead to unsound work which later investigators would invalidate In stressing the importance of the spirit in which problems are faced he had in mind chiefly however the importance of a critical attitude towards experimental methods and published results he uttered a much needed warning against the tendency to assume the validity of such results and the adequacy of an experimental technique without any rigorous verification of its suitability for the particular purpose in mind

It is unfortunately true that the critical spirit is not so general a characteristic of the young research worker whether in industry or in academic work as is desirable but this is only one indication that scientific training sometimes fails to impart the scientific spirit or the secret of scientific method A discussion recently held by the Institution of Mechanical Engineers starting from a group of papers on invention and the inventor made a valuable contribution in this field by its attempt to elucidate the mental characteristics of the successful inventor—an attempt in which we have made singularly little progress since the days of Francis Bacon

Some of the chief inventions upon which modern industrial development is founded such as the steam engine the power loom printing and gun powder were all made by persons working independently of scientific research It is true that the discoveries of science enlarged the bounds of invention and opened up much more fruitful fields for the inventor but the technique like the motive of discovery differs essentially from that of invention This is so widely true that the adequacy of invention as a basis of industrial progress is questioned by some shrewd observers who look instead to the much wider use of scientific methods in the acquisition and application of new knowledge

It is interesting in this connexion to note that Dr Lampitt attributed the unsatisfactory position of our knowledge of food problems partly to the use of hit or miss methods Such methods have occasionally been successful, as witness Charles Goodyear's discovery after ten years of such haphazard work that sulphur was the agent necessary to effect vulcanisation They are too prodigal of time and money to be applicable under the team work conditions prevalent in modern industry, and the firm or industry which clings to them is destined speedily to be outstripped by its competitors

Without providing us with a full philosophy of discovery, the discussion to which we refer although relating mainly to invention is highly suggestive in material from which such a philosophy might be evolved or at least in stressing factors to be cultivated in the training of those undertaking a career of scientific research The importance of accurate observation and experimental ability need no further discussion They have been accepted since Galileo's day as the basis of scientific research and Bacon's exposition of the possibilities of the scientific method assumed their use in the formulation and verification of hypothesis

The importance of an accurate knowledge of the present position as a starting point if duplication of effort is to be avoided should be obvious, but the importance of sifting that knowledge is often missed, as is the danger of paralysing initiative through excessive knowledge of detail At this point our modern examination system exercises some of its most baneful effects Only a clear understanding of what is involved in the scientific method and a firm grasp of its essential principles, can enable the young investigator to day to find his way through the literature bearing on his problem and avoid alike the mortification of merely repeating some previous work and the deterring or deadening influence of massed knowledge Creative science is as dependent as creative art upon a sense of values and upon intuition linked to imagination

The further suggestion was made that youth is an important factor in creative work By this we must understand the resilience and alertness of mind which are characteristic of those between twenty five and forty years of age, but by no means their monopoly Beyond that age, maturity of judgment and experience tend to be offset by habits of conservatism and complacency, not to mention the bondage of the preconceived idea from which comparatively few are able to free themselves So far as science is concerned, however, rash is he who attempts to fix an age limit beyond which brilliant discovery and creative thought are rare and unexpected On the contrary, Bavink pointed out quite recently that the really important discoveries in modern science are mainly the work of those who have long been at a position of eminence in their chosen field

If the charge of grooviness or lack of receptivity can rarely be brought against the real leaders of scientific thought, the important contributions which have come from those outside the industry in which the discovery or invention finds scope is a significant reminder of the value and inspiration which a fresh outlook may possess This is true not merely of scientific discovery but of invention also Benjamin Huntsman was a clock maker whose desire for better steel for his springs constrained him to invent crucible steel Henry Gort was a navy agent when he invented the puddling process for wrought iron and Arkwright was a barber before he applied himself to the problems of spinning

To the influence of professional organisations which may at times impede progress we have recently referred, but there are other personal qualities which are important The ability to utilise the literature without being suppressed by it is largely dependent on a capacity for assimilation which in genius is often limited to a narrow field The born organic chemist may be almost unteachable as regards mathematics, and a mechanical genius may find electricity a sealed book

The place of initiative in the make up of the investigator has already been emphasised The capacity for concentrated effort is another important factor and while a capacity for taking infinite pains does not constitute genius, genius is rarely without that capacity, at least in directions which serve its ends Moreover, this capacity for concentrated effort is closely related to that desire to see the work executed in the most thorough and efficient way which is an essential part of the scientific spirit

There are many other qualities which are to be found or desired in the scientific investigator and which condition his success whether in industrial or in purely scientific work In both, the capacity for co operation is of growing importance Both classes are required, though in varying degree, to co-operate with other workers, sometimes in different branches of science, in an attack on a 'common objective' Both are sometimes concerned with enlisting the interest and support of those possessing merely traditional or practical knowledge ; and both are also interested in the wider dissemination of the new knowledge, particularly in our technical schools.

To get a more scientific basis into industry, particularly our traditional industry, involves close co-operation between the man of life-long experience and the scientific worker. Such co-operation has a cumulative effect. It does far more than merely assist in the conduct of the industry on scientific lines, the solution of fundamental problems, or the reconciliation of art and industrial practice and craftsmanship The new problems it throws up provide a continual and invaluable stimulus to the scientific worker, which of itself is likely to yield rich fruit in the creative work which it incites.

Rontgen, and the Discovery of X-Rays

Wilhelm Conrad Rontgen and the Early History of the Roentgen Rays By Otto Glasser With a Chapter *Personal Reminiscences of W C Rontgen*, by Margaret Boveri Pp xii+494 (London John Bale, Sons, and Danielsson, Ltd , 1933) 32*s* 6*d* net

LOOKING backward we can see very clearly the monumental character of the discovery of the X-rays by Wilhelm Conrad Rontgen in November 1895 This was truly the beginning of the 'new physics' and the first of a series of profound and basic revelations, which even now show no sign of ending It is given to few men of science to make discoveries which attract world-wide and lasting attention, but the X-rays with their amazing penetrating powers, and their immediate and beneficent application in medicine, made an appeal to men of science and laymen alike, which is not likely to be surpassed in our time Röntgen's discovery in fact, as Sir J J Thomson remarked in his Rede lecture on July 10, 1896, "appealed to the strongest of all human attributes, namely, curiosity"

The recent publication of a biography of Röntgen by Dr. Otto Glasser is a timely reminder of very stirring days. At the period of his discovery, Prof. Röntgen was in his fiftieth year, and held the position of director of the Physical Institute of the University of Würzburg He was born at Lennep, in the German Rhineland, but his early youth was largely spent in Holland, to which country his parents emigrated when he, an only child, was three years old He had a chequered school life at Utrecht, which ended in his taking up at the age of twenty years the study of mechanical engineering at the Zurich Polytechnic School Three years later he obtained his Ph D and was appointed assistant to Kundt, who had succeeded Clausius in the chair of physics at Zurich Kundt's friendship helped to settle Rontgen's future career for him, and he accompanied Kundt when the latter was called to Wurzburg and afterwards to Strassburg At the age of thirty-four years, Rontgen was appointed professor of physics at Giessen, and nine years later (in 1888) succeeded Kohlrausch at Wurzburg

Rontgen's interests were spread over a wide range of physics, though most of his published papers dealt with heat and general physics He devoted, however, considerable attention to pyro- and piezo-electrical effects in crystals, and in 1888 he conducted important fundamental investigations which established the magnetic effects resulting from the motion of a dielectric between two electrically charged condenser plates Rontgen's outlook on physics was thoroughly classical and his natural bent for exact experimental work, which had been strengthened by the influence of Clausius, remained with him all his days He made little use of mathematics, but got his results with ingenious and simple equipment much of which he constructed himself He greatly appreciated an ability to improvise apparatus, and held the view that a man should be able to make everything really necessary with a pocket knife It is, therefore, not surprising that he normally dispensed with the services of an assistant and preferred to make his own observations

Rontgen had been at Wurzburg some five years when, in the early part of 1893, Helmholtz (then president of the Reichsanstalt) in a remarkable paper published in *Wiedemanns Annalen* in 1893, predicted the properties of electromagnetic waves of various lengths, and *inter alia* forecast a high penetrating ability and small refrangibility for waves of atomic dimensions There is no evidence, however, that Rontgen was influenced by this paper when in October 1895 he decided to make some experiments with cathode rays Rather would it appear that he was attracted by the contemporary work of Hertz and Lenard on electrical discharges in evacuated tubes Following Lenard's practice, Rontgen completely enclosed the discharge tube within black paper The room was darkened and Röntgen, who was working alone late in the evening, saw a small piece of paper painted with barium platino-cyanide and lying on the bench, shine out brightly. This was on Friday, November 8, 1895 Röntgen kept his own counsel for several weeks, apparently telling neither his staff nor his wife, who could find no explanation of his lateness for meals, his lack of appetite, his ill humour, his complete absence of conversation and his hurried returns to the laboratory Rontgen was, in fact, slowly convincing himself by repeated experiments that he was not the victim of hallucination and that here was a new type of radiation with penetrating powers which appeared incredible He presently came to appreciate the full significance of his discovery, and with the remark to his wife "Now the devil will be to pay" released his momentous announcement in the form of a preliminary communication "On a New Kind of Rays" which he presented to the Physical Medical Society of Wurzburg at the end of December during the Christmas recess.

This paper was printed and circulated prior to reading. In it Rontgen clearly identified the source of the "X-rays", as he styled them, with the region of impact of the cathode rays on the glass walls of the tube He also established the dependence of the penetrability of the rays on the density and thickness of the obstacle, their properties of exciting fluorescence and affecting a photographic plate, the absence of regular reflection or of appreciable refraction (the refractive index of water was less than 1 05), the absence of magnetic deflection, etc He inclined to the view that the rays were longitudinal vibrations in the ether. The paper was supplemented by shadow pictures of many objects, including the bones of the hand

Röntgen sent copies of his paper and X-ray pictures to a number of friends, including Sir Arthur Schuster at Manchester, who wrote an article on the rays in the *British Medical Journal* of January 11, 1896. The news of the discovery first reached London on January 6 and was thence cabled the world over Rontgen's paper was speedily translated into many languages. NATURE first referred to it on January 16, and followed this up with a translation of the complete paper on January 23. Mr. Campbell Swinton appears to have published in January the first X-ray photograph taken in Great Britain. On January 27, Sir J. J. Thomson described his experiments on the X-rays to the Cambridge Philosophical Society, experiments which, one recalls, speedily led him to the study of gaseous ionisation and conduction, followed a year later by his discovery of the electron. The world acclaimed another monumental discovery, and the Cavendish Laboratory, under its famous chief, became a magnet for the physicists of every land

Among other British X-ray pioneers were Sir Oliver Lodge, Lord Blythswood, Prof A W. Porter, Dr J MacIntyre, Prof Silvanus Thompson, Sir James Mackenzie Davidson and Sir Herbert Jackson, each of whom made important contributions The first journal in the world to be devoted exclusively to X-ray matters was founded in Great Britain by Sidney Rowland in May 1896, under the title of *Archives of Clinical Skiagraphy*. This is now the *British Journal of Radiology* The British Rontgen Society, which was founded in 1897, was also the first society to be originated in any country with the object of studying the X-rays Röntgen was one of its first honorary members.

Dr. Glasser's arresting book includes many examples of the amazing interest excited in the public press, both popular and scientific Ludicrous misconceptions prevailed in many quarters The new rays would render privacy impossible The *Pall Mall Gazette* in March 1896 referred to the "revolting indecency" of it all and called for legislative restriction of the severest kind Mr *Punch* found repeated inspiration in the rays for both rhyme and cartoon. The most fantastic stories found credence, despite openly voiced scepticism in some quarters of any semblance of truth in the discovery. Reams of sensational matter emanated from Edison's laboratory in America. "he and his staff worked through seventy hours without intermission, a hand organ being employed during the latter hours to assist in keeping the force awake". Fortunately the pace was too hot to last, but until the general fever of excitement had abated, the new rays became in many countries the tool of the charlatan, who exploited them as his fancy lay, whether in the direction of alchemy, vivisection, spiritualism, telepathy, soul photography or soothsaying.

On March 9, 1896, Rontgen submitted his second communication to the Würzburg Physical Medical Society. He refers to the superiority of a platinum target as a generator of X-rays and the successful use of a concave cathode and a 45° target (a design which Crookes had developed in 1879 for other purposes). He remarks on the usefulness of a Tesla transformer as a means of exciting an X-ray tube. Most of the memoir is devoted to the action of X-rays in discharging electrified bodies in air.

A year later (March 10, 1897) Röntgen published his third and last memoir. He remarks on the scattering of X-rays by air, on the general uniformity of emission of X-rays from a tube in different directions, on the different penetrating powers of rays from 'soft' and 'hard' tubes, on the gradual hardening of X-ray tubes with use, etc

After his third memoir Rontgen published little more on X-rays He left Würzburg in 1900 for Munich, where he resumed his early researches on the physical properties of crystals Laue's famous crystal diffraction experiments on X-rays in 1912, followed by those of the Braggs, must have afforded Röntgen great gratification He himself had unsuccessfully tried to reflect and diffract the rays, and he also lived to see in 1922 A H Compton specularly reflect X-rays from glass and silver at tiny glancing angles In 1924, a year after Röntgen's death, Siegbahn and his coadjutors prismatically refracted the rays, the angle of deviation for a glass prism amounting to only a few seconds of arc, the refractive index being less than unity, as forecast by the classical Drude-Lorentz theory of dispersion In 1925, A. H. Compton and Doan successfully diffracted the X-rays by the use of ruled gratings on speculum and extremely small glancing angles The nature of the X-rays was long the subject of controversy, but these several experiments all played their part in finally establishing the position of the rays as radiation with wave-lengths of the order of atomic magnitude.

For some years distinctions were lavished upon Röntgen, but his essential modesty and shyness remained unaffected He refused to derive any financial advantage from his discovery, nor would he consent to lecture either to the Reichstag or the British Association. He received jointly with Lenard the Rumford medal of the Royal Society. He declined the title 'von', and the offer of the presidency of the Reichsanstalt in 1904 The first Nobel prize for physics was awarded to him in 1901, and in his will he left the prize to the University of Würzburg, but this together with his personal fortune became valueless as a result of the deflation after the War.

Miss Boveri, a close friend of Rontgen, contributes to Dr. Glasser's book an intimate personal study of Röntgen. There is an amusing story of how Röntgen, who had an excitable temperament and had been rather spoiled as a boy, became embroiled in a terrific argument with his wife during a walk. In his anger he stopped a passing cab, bundled her into it, paid her fare home and continued his walk alone He was fond of cards, but a bad loser · he would pound the table when his hand was a poor one, and if his partner played badly he would become so angry that some of his friends refused to play with him under any consideration However, these were minor weaknesses He was kind-hearted and fond of children, and having none of his own, adopted a niece of his wife's Rontgen, who was cautious, reserved and extremely independent, did not make friends easily He was fond of outdoor life, and never lost his love of certain of the Swiss alpine resorts, where his tall athletic bearded figure was well known He had a strong aversion to motor-cars Everything he did he took up with great intensity and zest He hated speeches and rhetoric in any form and his lectures, sound and clear though they were, did not make wide appeal to his students He refused, as he said, to 'pamper' them, and the ill-prepared dreaded his examinations, because he did not regard routine questions as a test of intelligent knowledge

During the War Rontgen allowed himself to be persuaded into signing the proclamation of the 'ninety-three intellectuals' and gave up his Rumford medal to be melted for gold, but in his later and calmer years he regretted that he had been led into such matters He derived great consolation that his discovery had contributed so much to the amelioration of the suffering of the wounded among friend and foe He died in his seventy-eighth year on February 10, 1923.

Many have wondered that the discovery of X-rays had not been made long before it fell to Röntgen, for numerous workers must have produced the rays in abundance, certainly during the previous fifteen years It was perhaps inevitable, therefore, that the flood of contemporary appreciation was tinged here and there with not overkindly comment, but in looking backward we may recall with Dr Glasser the words of Kircher, a seventeenth century predecessor of Röntgen, who remarked, "Nature often allows amazing miracles to be produced which originate from the most ordinary observations and which are, however, recognised only by those who are equipped with sagacity and research acumen, and who consult experience, the teacher of everything".

G. W C. KAYE.

Physical Chemistry of the Proteins

Handbuch der Kolloidwissenschaft in Einzeldarstellungen . Herausgegeben von Prof Dr Wolfgang Ostwald Band 6 *Kolloidchemie der Eiweisskorper* Von Prof Dr Wo Pauli und Dr Emmerich Valkó Zweite völlig neu bearbeitete Auflage Pp xiv+353 (Dresden und Leipzig Theodor Steinkopff, 1933) 28 gold marks

THE first edition of this monograph was published in 1920, since that time there have been important developments both in the theoretical and the practical aspects of this subject, among which may be mentioned the conception of the amino acid as a *zwitterion*, the general adoption of the activity notation, the measurements of molecular weights of proteins and the application of the interionic attraction theory of strong electrolytes to protein systems

In the preparation of the second edition, Prof Pauli has been assisted by Dr Valkó, who is joint author with him of the larger textbook "Electrochemie der Kolloide" The authors are to be congratulated in that they have gone far towards the achievement of the purpose set forth in the general preface to the series of monographs by their general editor, Prof Wo Ostwald, namely, that the publications should serve the purpose of collecting and correlating papers on the subject of colloid science that are widely dispersed through an extremely large number of diverse journals The authors have amassed data from physical, chemical, biological and technical publications, and the mode of presentation is much to be commended, in that the results under discussion are largely given in the form of tables and curves, and diagrams descriptive of the technique employed are provided in many cases

The chapter in which the mobilities of protein ions are discussed is of special value, as it includes a description of the methods and results of Tiselius, which were published in a journal difficult of access. The section dealing with the hydration of proteins is a lucid and discriminating summary of the subject, in which special prominence is given to the interesting researches of Sørensen, of Weber and of Moran

The reference made to the work of Sørensen, Linderstrøm-Lang and Lund is rather brief in view of its importance. Their paper included the first definition of the isoionic point, and a comprehensive study of the effects of salts on the ionisation of proteins The studies of gas and electrolyte equilibria in the blood, published by Van Slyke and his colleagues, have been omitted.

It is to be regretted that the second chapter, entitled "The Chemistry of Proteins", should be so short, and that allusion to the stimulating papers of Max Bergmann should be restricted merely to references The hypothesis due to K H Meyer and Mark, that the protein molecule consists of a long main valence chain, is given greater prominence Reference is made to Meyer's hypothesis that protein exists in solution in the form of aggregates or micelles In the light of Svedberg's work on the constancy of the molecular weights of proteins over a range of protein concentrations described in Chap xiii, it would seem that the aggregation theory cannot have an universal application Svedberg has shown, moreover, that in the case of many proteins, the sedimentation velocities agree with those calculated for spherical molecules

The recent investigations of Sørensen and his colleagues on the fractionation of proteins, and the solubilities as affected by the mass of the solid phase, are described in Chap vii Sørensen has concluded that purified proteins are not chemical individuals, but systems of components which dissociate reversibly The solubilities of fractionated globulins indicate that the solid phases may be complexes of eu- and pseudo-globulin

Many tables of data relating to the physical properties of proteins, including their dielectric constants, have been given, a very considerable part of this material is not available in any other textbook on proteins. As an inclusive summary of recent investigations in this field, the handbook of Pauli and Valkó should be most useful to those interested in the physical chemistry of the proteins.

G S. ADAIR

Micro-organisms and Insects

L'Infection chez les insectes . immunité et symbiose. Par Dr. A Paillot Pp 535. (Lyon · Librairie médicale et scientifique, 1933) 100 francs

DR A PAILLOT has devoted a number of years to the study of the diseases and other microbic infections of insects. In the present work he reviews various aspects of insect microbiology and incorporates the result of his own researches The broader theoretical problems of immunity and symbiosis are discussed at length, while the morphology and biology of a large number of disease, and other, organisms are clearly described and figured This volume is not an exhaustive treatise on its subject, such an aim was not the author's intention The reader will find some phases more fully treated than others, while certain aspects are omitted, or come in for very cursory mention

The book is divided into seven parts of these, the first four parts deal respectively with maladies of protozoan origin, fungal diseases, diseases due to viruses and to bacteria The fifth part is concerned with anti-bacterial immunity and its phases among insects The author discusses at length the subject of natural and acquired immunity and concludes that they are due to both cellular and humoral reactions He considers, however, that the experimental evidence shows that the reactions of the blood plasma itself are of greater importance in this aspect than cellular, or phagocytic, activities

Part six is a very full account of symbiosis in various species of aphides Symbiosis is not discussed with reference to other insects since the author's original observations are concerned with the group just mentioned This part includes a very full account of the cytology and the transmission of the specific micro-organisms from generation to generation of their hosts The biochemical side of the subject is not discussed and we are still in the dark as to the nature of the mutual reactions that are involved Dr Paillot elaborates the interesting theory that symbiosis in aphides has developed from bacterial infection The micro-organisms, he claims, have been able to establish their permanent relationship owing to a progressive diminution of their virulence, so that they have become completely inoffensive and ultimately beneficial Part seven is concerned with the practical side of insect microbiology The utilisation of disease organisms in pest control and their rôle in the transmission of human and animal maladies are discussed in this section

The book concludes with a classified bibliography, running to about fifty pages, together with indexes to subjects and authors' names

A D IMMS

Short Reviews

Allen's Commercial Organic Analysis Vol 10 *Hæmoglobin and its Derivatives, Albuminoids or Scleroproteins, Structural Proteins, Examination of Foodstuffs for Vitamins, the Hormones, the Identification of Unknown Woods and Charcoals, the Pectic Substances* Editor Dr C Ainsworth Mitchell Fifth edition, revised and partly rewritten Pp xi+817 (London J and A Churchill, 1933) 32*s*

WITH the publication of the tenth volume of "Allen's Commercial Organic Analysis", the fifth edition of this comprehensive work is completed A decade has passed since the issue of the first volume of this edition and, in the interval, many branches of applied chemistry have increased in importance, even now a part of this edition is out of date, especially for data contained in the volumes published so far back as 1924 or 1925. The editor has taken advantage of the issue of this final volume to include a number of subjects of recent technical importance, so that there is no definite connecting link between the subject matter of the various chapters These new sections include such subjects as hæmoglobin, albuminoids, vitamins in foodstuffs, hormones and special wood charcoals A section on fibroids in a former edition has now been extended and includes a large amount of data on natural and artificial silk, furs, hairs and wool. Pectin substances have been given special consideration and the qualitative and quantitative examination of such substances is considered.

The reviewer has had an opportunity of checking the methods of pectin analyses given in the work and finds them very detailed and reliable In the estimation of pectin substances (p 524) there is an inaccuracy in the making up of the standard solution, and the subsequent statement that a molecule of furfural liberates exactly two atoms of bromine from potassium bromide might be expressed differently

This final volume also includes a useful 250-page subject index supplement for the whole edition The fifth edition of 'Allen' is the most authoritative and complete work on commercial or applied organic analysis which has ever been published. It is absolutely indispensable to the analyst and works chemist, and no chemical reference library will be complete without it

J REILLY.

A Handbook of Child Psychology Edited by Carl Murchison (The International University Series in Psychology) Second edition revised Pp xii+956 (Worcester, Mass · Clark University Press, London. Oxford University Press, 1933) 24*s*. 6*d* net

IF one turns over the pages of a psychological treatise written a generation or two ago, one finds that what it mostly comes to is a patient analysis of adult consciousness, the method employed being that of introspection. Experimental psychology, involving objective measurement and claiming to be scientific, was slowly making its way, and is now very extensively cultivated *Of* child psychology the same can scarcely be said. James Sully's "Studies of Childhood" (1895) was in Great Britain a pioneer book and is still quotable. But certainly not in Great Britain, nor even in the United States, has child psychology received the attention of the ablest investigators to the extent which one would have thought to be its due Therefore genetic as distinguished from analytic psychology has suffered

That progress is being made, however, is shown by the latest addition to the International University Series in Psychology So rapidly is the subject advancing that this second edition of the "Handbook of Child Psychology" bears little resemblance to the first, published little more than three years ago In twenty-four closely packed chapters the latest work on the scientific study of children is summarised, not for the general reader, but for experts, by experts As the book is of American origin it would in any case have been natural that most of the contributors should be American, but as a matter of fact it was inevitably so, because most of the research work has been done by Americans Single contributions come also from Toronto, Vienna, Berlin and Geneva, but none from Great Britain. Ten of the contributors are women, one of whom makes a remark which some of the men would do well to take to heart "Too much work upon these problems is being done with paper and adding machines, and too little with human beings"

Recent Advances in Psychiatry By Dr Henry Devine Second edition Pp xi + 364 (London J and A Churchill, 1933) 12*s* 6*d*

It is very gratifying to note a marked improvement in the second edition of this book The first edition was very good, but Dr Devine is to be congratulated on the additions and alterations he has made Three new chapters have been added, dealing with "Germinal Inheritance in the Psychoses", "Mental Disturbances in Pernicious Anæmia" and "Mental Disorders and Deficient Oxidation"

It is a very great pity that the work on toxic foci in the psychoses is practically uncontrolled There is need of the investigation of a series of 1,000 normal cases, particularly with reference to the presence of infections in the sinuses and the bowel. The work of the toxic schools is unconvincing without control.

We would like to have seen some mention of the use of diathermy in the treatment of general paralysis of induced pyrexia The use of malaria is attended by a certain death-rate due to the malaria alone The results from diathermy are just as good as from malaria, particularly if combined with tryparsamide. In the next edition, will Dr Devine give us a chapter devoted to occupational therapy, which plays such a very important part in the modern treatment of mental illness?

This is one of the best British books on psychiatry.

Handbuch der Physik Herausgegeben von H. Geiger und Karl Scheel Zweite Auflage. Band 24, Teil 1 · *Quantentheorie* Redigiert von A. Smekal. Pp ix + 853. (Berlin Julius Springer, 1933) 79 gold marks

The advances in quantum theory have of late been so rapid that most workers in theoretical physics must appreciate the publication of vol 24 of the well-known "Geiger-Scheel Handbuch der Physik" Part 1 of this volume is now available, unfortunately, it is impossible to do more than outline its contents here It contains a description of the origin and development of the older or classical quantum theory by Rubinowicz, followed by a treatment of the general principles of wave mechanics by W Pauli Bethe discusses the quantum mechanics of one- and two-electron problems, while Hund contributes a very important article on the quantum mechanics of atomic and molecular structure Wentzel is responsible for a section on collision and radiation processes, and N F Mott contributes the concluding section on the application of wave mechanics to nuclear physics The whole production is of the same high standard of excellence as its precursors

Manipulative Surgery By A S Blundell Bankart (Modern Surgical Monographs) Pp xii + 150 + 17 plates (London · Constable and Co, Ltd, 1932) 7*s* 6*d* net

If the practice of manipulative surgery is almost a monopoly of the bone-setter, the medical profession alone is to blame The art of manipulation, with its therapeutic indications and contra-indications, has received but scanty attention in the curriculum of the medical student, the average doctor's complete ignorance of the subject is not surprising Mr. Bankart's book, which is intended for the student and general practitioner, is consequently of value in two ways It demonstrates that a large field of minor orthopædic practice is well within the limitations of any doctor who cares to learn its principles and who remembers his studies in anatomy; and to the physician who does not wish to acquire the art it indicates the large number of conditions which can suitably be referred to the orthopædic surgeon, instead of being allowed to drift into the risks of treatment by the unqualified practitioner

The Blue Book, 1934: the Directory and Handbook of the Electrical and Allied Industries 52nd edition Pp 1474 + xxx (London: Benn Bros, Ltd, 1934.) 25*s*. net.

This handbook is almost a necessity to everyone engaged in the electrical industry. The handbook section contains the latest data concerning conductors and insulators. It includes a map of the completed grid in Great Britain and a list of overseas telephone routes and rates. The alphabetical, geographical, colonial and foreign sections contain information in a convenient form which would be difficult to find elsewhere.

The British Polar Year Expedition to Fort Rae, North-West Canada, 1932-33

By J. M. STAGG

THOUGH the special and continuous needs of meteorology, terrestrial magnetism and allied sciences for systematic observations over wide areas and in high latitudes had been felt long before 1882–83, it was not until then that a large-scale effort was made by twelve countries to study events in those subjects through a full year according to an agreed plan. In collaboration with Canada, Britain's share in that First International Polar Year, as the twelve months ending August 1883 has come to be called, was to equip a party under Capt Dawson, R E, for continuous observations in meteorology, terrestrial magnetism and aurora to be carried out at Fort Rae, a trading outpost of the Hudson's Bay Company on the Great Slave Lake, North-West Canada Practically and scientifically, from the point of view of international collaboration as well as that of Britain's own participation in it, the year's activities were completely successful

As the jubilee of that First Polar Year approached, it was felt in many quarters that no time could be more appropriate for a repetition on a much more extensive and intensive basis In the three primary subjects then investigated, advances in recent years have been large, and mainly all in the direction of indicating that further progress depended on the gathering of more precise observational material from a still wider field and to the limits of the atmosphere The sequences of weather changes over limited regions like Britain in moderate latitudes might well be determined by conditions in the stratosphere far to the north or south, days or weeks ahead the short-period irregular changes in the earth's magnetic field, known to be intimately associated with the state of ionisation in the conducting layers of the high atmosphere, seemed to be bound up with auroral activity on one hand and the interruption of long-distance wireless communication on the other To a few even it has seemed not improbable that these two domains, the apparently locally determined meteorology and the more cosmically produced aurora and its effect on the earth's magnetic field through the intermediary of the ionosphere, might be interconnected. Such were the questions in many cases speculation and theory had outstripped fact.

So in 1929 the time was ripe for the proposal of a Second Polar Year for 1932–33. An International Polar Year Commission was set up with the directors of the meteorological services of many countries as members and Dr. la Cour of Copenhagen as its president. National committees were constituted to carry out the general recommendations in each country. In Britain, with Sir Henry Lyons as its chairman, and Dr. G. C. Simpson as secretary, the National Polar Year Committee has had representatives from the Royal Societies of London and Edinburgh and from six other interested institutions A grant-in-aid of £10,000 by the Government through the Air Ministry has been the primary source of supply for the Committee's activities, though many manufacturing and wholesale firms have contributed to the fund by generous gifts of food and instrumental equipment and even of money

Britain's share in the international programme has been fourfold

(1) The provision of new instruments and facilities for conforming to the general plan of observations at some permanent meteorological stations and observatories in the country as well as on ships at sea

(2) An intensified programme of auroral observations and photography in Scotland and in the Orkney and Shetland Islands.

(3) An extensive and novel series of observations on the variation in height and intensity of ionisation of the conducting layers in the high atmosphere, by Prof E V Appleton and his party at Tromsø

(4) The equipment and manning of a station at Fort Rae, Canada, for complete and continuous observations in meteorology, terrestrial magnetism, aurora and atmospheric electricity

The Fort Rae party under J M Stagg comprised Messrs W R Morgans, P A Sheppard, and W A Grinsted (Meteorological Office) with Mr A Stephenson (Cambridge) as observers, and Mr J L Kennedy as mechanic and steward. With sixteen tons of instrumental and foodstuff equipment, the party left England in May 1932 and journeyed by the usual route to Edmonton, Alberta, thence northerly for about a thousand miles, using the Hudson's Bay Company's river transport for the trip down the Athabasca and Slave Rivers, and so across the Great Slave Lake to its northern extremity The site of the station was reached by the middle of June

To ensure that all the instrumental equipment would be in full running order and the routine of observation thoroughly established by August 1, the starting date for the overlapping 'year' of thirteen months, every minute before then was required for erecting special huts and getting the autographic recording instruments in action. These covered every one of the main aspects of meteorology and terrestrial magnetism, and included a new type of magnetograph designed at Copenhagen, in which the variometers for the force components were optically compensated for temperature changes, and with a recorder arranged so that the time of incidence of sudden changes in the magnetic field could be read with an accuracy of two seconds. It is of interest to note that, using this magnetograph, a 'sudden commencement' of a magnetic disturbance on April 30, 1933, was judged to appear practically simultaneously at places so far apart as Copenhagen, Thule (in north-west Greenland) and Fort Rae

Nearly all recording instruments were run in duplicate to make sure that the records would be as complete as possible, the secondary records in most cases providing the additional safeguards of furnishing data with other characteristics, as, for example, a more open time-scale or lower sensitivity

As part of the programme of meteorological work, more than four hundred pilot balloon ascents were made during the term of occupation of the station and twenty-eight *ballons sondes* were sent up The hydrogen for this work was manufactured on the spot in a new apparatus designed at the Airship Works, Cardington, and was produced by the interaction of granulated silicon with heated caustic soda Two of the instruments from *ballons sondes* released in winter with surface temperatures about -30°C attained heights of 16 km In both cases, the base of the stratosphere was very well marked at 8 5 km and with temperatures about -60°C

With Fort Rae in an exceptionally good position relative to the zone of maximum auroral frequency, much importance was attached to the observations and photography of aurora for precise determinations of its height and orientation To a substation (which was actually the site of the station in the First Polar Year fifty years ago) some 25 km to the south-east, a telephone line was erected allowing photographs of the aurora to be taken simultaneously by cameras specially designed for auroral work in Norway From these pairs of photographs, some 4,700 of which were taken by the party during the stay at Rae, it is hoped to obtain much definite information about aurora in that part of Canada Although the period was so near the minimum of the present cycle of solar activity, aurora was observed at some time on every night when conditions were practicable It was not infrequent during the winter months for aurora to continue almost uninterruptedly for fifteen hours

In addition to the activities in these, the main lines of investigation, observations in atmospheric electricity claimed much attention Continuous records of the potential gradient of the earth's electric field near the surface were maintained autographically, and frequent measurements of air-earth current and small ion content of the air were made Experiments were also carried out to determine the nature of the diurnal variation of these quantities and also of the rate of production of ions near the ground

The winter conditions at Rae during 1932–33 were characterised more by the steadiness of the cold than by extremes of temperature reached Over the seven months ending April 30, 1933, the average temperature was -20°C, but the lowest average for any single month was only -31°C — January and February were almost the same in this—and the lowest daily mean was only -40°C During the short warm summer, daily temperatures frequently exceeded 20°C

The party returned from Rae in September and early October 1933 with a very large amount of observational matter for further study It is now the intention that each country participating in the international programme should make all its data available by reduction and publication as early as possible, so that the larger and more important task of co-ordination of the results from all the stations may not be delayed In many ways it was unfortunate that the Second Polar Year should have coincided with times of such grave financial stringencies in so many countries But the difficulties encountered in the preparations both by the International Commission responsible for the general organisation of the Polar Year activities and by the individual national committees in each country served to emphasise the value of the work It is certainly illuminating that forty-six different countries have taken part in the programme in one way or another, and of these, twenty-three have set up extra stations—in many cases more than one—either within their own territory to extend the number of their regular observatories, or outside their own lands as temporary observation posts

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Progress of Industrial Research

IN a recent address Dr F A Freeth made an eloquent protest against the habit in Great Britain of always classifying science as something apart from ordinary life It would be difficult to imagine a document better fitted to demonstrate the essential place of science in our ordinary everyday life, or to inspire a general confidence in scientific workers and science by the public, than the eighteenth annual report of the Department of Scientific and Industrial Research * Published within a couple of days of Dr Freeth's address, the report describes contributions made by the work of the Department to every major need of our social and industrial life. The comparatively small sum of £654,736 (gross) or £451,987 (net), which represents the expenditure of this Department for the year ending March 31, 1933, represents also a contribution to the efficiency of every department of State and to the recovery or the prosperity of many industries, the true value of which it is impossible to assess in cash, but which repeatedly has earned dividends many hundred-fold on the expenditure involved

Even this expenditure, however, represents a further decrease on that recorded in the previous report—£695,677, the actual expenditure in 1931–2 being £543,700 Receipts, however, increased from £160,977 to £202,749, thus exceeding those of 1930–31 (£184,829) Expenditure on the National Physical Laboratory was £195,316, against which receipts amounted to £90,854 , on the Chemical Research Laboratory, £18,406 net , Forest Products Research, £32,286 net , Fuel Research, £84,226 net , Radio Research, £11,340 net , water pollution, £8,642 net and Headquarters Administration, £24,791 net Against expenditure of £44,583 on Food Research, a grant in aid of £30,133 from the Empire Marketing Board assisted to bring the net expenditure to £10,774 Receipts of £7,380 bring the expenditure on Building Research to £34,663 net, while the £46,140 balance of the Million Fund brought the Grants for Research to a total of £51,700 net

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* Department of Scientific and Industrial Research Report for the Year 1932–33 (Cmd 4483) Pp iv+189 (London H M Stationery Office, 1934) 3s net

A large part of the report of the Advisory Council, over Lord Rutherford's signature, which precedes the summary of work, is devoted to a discussion of the 'million fund' to which reference has already been made in NATURE of January 20, p 77 The same report, however, also refers to the transference to the Department from the Ministry of Transport of the responsibility for the direction and supervision of road research This is a matter of direct concern to every citizen whether he uses the roads in his own car or in public vehicles The traditional methods of road making were designed to provide a surface sufficiently firm to prevent slow-moving horse traffic from sinking appreciably in wet weather Despite the revolutionary changes which have taken place with surprising success in the last thirty years, we have still very little scientific knowledge either of the foundations of the road or of the materials of its superstructure such as will ensure that a success in one place can be repeated in another A systematic programme of research has been prepared, covering not only the testing of the materials but also the processes involved in road construction, maintenance and use One of the most important requirements for success in laboratory investigations is correlation between behaviour in practice and the results of laboratory tests Such correlation in road work is a protracted process, as the information from practice is obtained only after the road has been in existence many years Results from road tests at the Harmsworth Experimental Station, for example, are incomplete after 3½ years of heavy traffic, and to accelerate progress attention is being given to the development of road testing machines

Other work bearing on transport is also being carried out by the Department The Chemical Research Laboratory is investigating the properties of road tar, while investigations to discover the most suitable traffic signal beams have been carried out at the National Physical Laboratory, the results of which, after tests on signals in actual use at Reading and in Oxford Street, London, have been embodied in a British Standards specification Other work at the National Physical Laboratory on motor-car headlights has led to a method of determining the light distribution which should be aimed at for a headlight beam

The National Physical Laboratory has also been concerned with other methods of transport Its Aerodynamics Department has been responsible for much important work bearing on the design of new types of aeroplane and particularly on stability and control of aeroplanes, including an investigation on the spinning properties of typical aeroplanes The corrosion fatigue of certain aircraft materials has been studied by the Engineering Department, the Sound Division has rendered assistance in connexion with the acoustical features of aircraft design The recent series of aviation disasters alone should indicate the great importance of work on systems of direction-finding which is proceeding under the Radio Research Board

Research on the design of hulls and propellers for ships carried out on models at the William Froude Laboratory, dealing with the influence of waves on the resistance, propulsion and pitching of ships has reached a stage when the general effects of rough water upon the hull resistance are known Such progress has been made with the study of the action of a screw propeller when propelling a ship in a rough sea that performance can be predicted with confidence from model tests In addition, investigations have been carried out to determine the effect of wind forces from any direction on the steering of ships

Particular stress is laid on timber research in the Report of the Advisory Council The work carried out in the Forest Products Research Laboratory covers the working and finishing properties of wood, as well as its natural durability and its resistance to insect or fungus attack, which is of widespread importance to the builder of houses or maker of furniture, etc It is, however, only one link in a chain which connects the forest in the Empire Overseas with the timber user in Great Britain The other two links, information on prices and supplies and marketing promotion, are seriously threatened by the disappearance of the Empire Marketing Board, and upon their continuance much of the utility of the research on timber depends

Timber naturally suggests building and the work of the Building Research Station provides many illustrations of the influence of scientific research on the comfort and efficiency of the home These include investigations on factors influencing weathering, a study of the most economical means of heating a house, which indicated the superiority of the intermittent method, investigations on plasters, on the problem of damp walls, the exclusion of solar heat by thin roofs, on painting on cement and plaster Other contributions in this field come from the work of the Research Associations Such, for example, are those dealing with frost-bursting of water-pipes of various materials, with methods for preventing the corrosion of galvanised hot-water tanks or the dulling of bright metal surfaces used in architecture, both inside and outside buildings. Investigations on earthing to eliminate risks of electrical shock have continued: a comprehensive survey of causes of radio interference due to the operation of electrical equipment is proceeding, while at the National Physical Laboratory the transmission of sound through partitions or double windows is receiving attention with a view to better design of rooms and houses, nor should we overlook the work which is being carried out on steel frame buildings.

A method of determining the efficiency of hot plates is being standardised, and the discovery of a means for reducing the temperatures reached by gas-filled lamps in show-case and shop-window fittings has definitely reduced the risk of fire in stores where inflammable goods are displayed

So much of the work of the Department has a direct bearing on public safety and health that its activities can quite legitimately be summarised as that of a great national life assurance department In addition to the industrial examples already given, space allows us to mention only two. the metallurgical research dealing with the factors causing the cracking of boiler plates and the work carried out on the production of a more efficient respirator for use in industrial processes as a protection against the inhalation of dust. From a more general point of view may be cited the search of the Chemical Research Laboratory for new drugs efficacious in the treatment of sleeping sickness in Africa, or the work on atmospheric pollution and water pollution.

Such a dry year as 1933 emphasises the importance of the latter field, and the report itself points out that two recent serious outbreaks of enteric fever in Yorkshire were both due to comtaminated water supplies Frequently the condition of streams and rivers cannot be improved sufficiently until satisfactory methods of reducing the amount or polluting nature of various domestic or trade effluents have been devised Since new types and sources of pollution are always arising, as, for example, the effluents from modern milk depots or factories, the department concerned is continually charged with fresh programmes for investigation.

The whole of the important food investigations carried out under the Department have a profound bearing on the national health. The quality of foodstuffs is continually being improved and waste eliminated bv means of better methods of transport and storage One effect of such work is to make possible a steadily rising standard of living. The Food Investigation Board has been responsible for work covering the storage of meat by freezing or chilling, the transport of bacon from Australia and New Zealand, the freezing and smoke-curing of fish, the gas-storage of apples, the storage of fruit for canning, and much effort is being given to the development of appropriate methods of studying the damage which fungi, etc, can produce in fruit and other foodstuffs The Flour Millers' Research Association has undertaken investigations designed to place the conditioning of flour on a scientific basis and is studying the effect of added oils and fats on the baking quality of the flour The Cocoa, Chocolate, Confectionery and Jam Trade Research Association has materially assisted in improving the making of marmalade, jams and jellies by its study of pectins, and has studied the development of means of combating insect pests of nuts and chocolates and other confectionery in retail shops and of remedying defects which develop in chocolate-covered wafers and candied peel. An outstanding investigation of the Food Manufacturers' Research Association has been the development of an instrument for determining the amount of salt in any part of a piece of meat during curing, and in consequence allowing of closer control of the process

Some will be surprised to learn that important dental research is being carried out under the Department, including the determination of the best composition of amalgams for dental purposes and the properties of widely-used dental rubbers, or that as a result of studies on aluminium paint made by the Paint, Colour and Varnish Manufacturers' Research Association it is possible to indicate the conditions which must be observed to avoid the loss of brilliance or other special properties

The relation of such research associations as those of the cotton, woollen and linen industries, or the Launderers' Research Association to our everyday needs is equally impressive The first, for example, has provided the industry with a new method for the rapid separation of good cotton from dust and other foreign matter The second has developed a method for treating the fibres in bulk before spinning, whether for woollen or worsted processes, which renders them unshrinkable, besides giving lustre and softer handling, thus eliminating the prickly feeling which sometimes causes discomfort in wearing woollen goods The same Association is developing reliable scientific tests for judging the fastness of dyed woollen fabrics to light and other agencies.

The Linen Research Association has not only established the causes of the comparatively rapid wear of double damask on laundering along lines near the selvedges but has also found a method modifying the cloth structure so as to enable it to withstand the laundry wear. The Launderers' Research Association has been responsible for tracing the cause of the development of holes in collars for which ordinary wear could not account and, as a sequel, for co-operation with the manufacturers to eliminate the defect. Moreover, the arrangement by which certain manufacturers have agreed to submit new fabrics to the Association for examination of the laundering properties before putting them on the market is one the importance of which to the public is obvious

Through the work of the Department, science is contributing not merely to industrial efficiency and safety, to public health and safety and social welfare, but also to a steady rise in the general standard of living and in the quality of the service rendered by our interdependent industries.

Obituary

PROF. DAVIDSON BLACK, F.R.S

THE untimely death of Prof. Davidson Black, which occurred on March 15 at the age of forty-nine years, deprives the Cenozoic Laboratory of Peking of its honorary director, who had unique qualifications of knowledge, temperament and technical training to make him the ideal man for such a position Not only had he in high degree the competence and personal qualities for the work, but he also had the enterprise and courage boldly to pursue the adventurous policy which has met with such conspicuous success When he entered the University of Toronto, Prof A B Macallum recommended him before entering the Faculty of Medicine to acquire some general training. Acting on this suggestion, Davidson Black studied anthropology and took an arts degree After qualifying in medicine he became instructor in anatomy in the Medical School of the Western Reserve University at Cleveland, Ohio At the end of 1913 he was made assistant professor of anatomy under Prof Wingate Todd, and after his marriage he came to England and worked at comparative neurology in my department in the University of Manchester

At that time I was working on the reconstruction of the Piltdown skull and the study of the endocranial cast obtained from it, and for purpose of comparison had collected casts of all the known fossil human skulls This work aroused a much greater interest in Dr Davidson Black than the brains of the Dipnoi in which I was trying to engage his interest, and he at once made himself familiar with all of the material I had collected, and informed me that that was the kind of work to which he was determined to devote his life He at once set to work to train himself for such a career, acquiring the technical experience and studying the geological literature which was essential for the field work he contemplated His attention was arrested by the writings of a fellow Canadian, Dr William D. Matthew, at that time a member of the staff of the American Museum of Natural History in New York In particular he was fascinated by the work entitled "Climate and Evolution" which was published in the *Annals of the New York Academy of Sciences*, and this gave Davidson Black the complete conviction that China was the place where primitive man was likely to be discovered Hence in 1916 when, after his military service, he was offered the position of professor of neurology in the Peking Union Medical College, he at once accepted the offer under the conviction that it coincided with the ideas he had formed as to his career.

In Peking, Davidson Black found a group of very agreeable colleagues with whom he entered into relationships of close friendship, in particular with Dr. A. W. Grabau, the professor of palæontology in the National University of Peking, who was destined later on to suggest the name *Sinanthropus pekinensis* which Davidson Black adopted for his great discovery To the group of young geologists in Peking, Grabau was the guide and friend. His delightful dinner parties served the purpose of keeping this group *au courant* with progress of geological knowledge, and also gave them perspective and a wide outlook upon the subject. In the course of the conversations which took place at these dinner parties, Davidson Black learned of the observation made by Prof Schlosser in 1903 of the discovery near Peking of an intriguing tooth which might be that of a primitive man This served still more to deepen his conviction that Peking was the promised land of his ambition.

When, in 1926, Dr. Gunnar Anderson announced that the expedition working under his direction had found an early Pleistocene tooth, a discussion arose as to whether or not it was human Its finder was indignant that the newspapers referred to it as the "Peking Man" Dr Davidson Black did not hesitate He regarded it as a definite confirmation of the hopes aroused by the writings of Matthew and Schlosser as to the early man he had gone to China to discover In 1927 he published (in *Palæontologia Sinica*) a detailed description of the tooth which Dr Bohlin had found, and on the basis of the evidence he cited he founded the new genus and species for which, on the suggestion of Prof Grabau, he applied the name *Sinanthropus pekinensis*

The severe criticism to which Davidson Black was exposed had no other effect upon him than to make him redouble his efforts to establish the proof of the claim he had put forward, and to intensify the search for fresh material He had a little brass case made to contain this tooth which he attached to his watch chain, and he made a tour of the world trying to enlist the support of the palæontologists of Europe and America for the new genus he had created on the evidence of the tooth The excavations which were carried on at Chou Kou Tien under his direction resulted in 1928 in the discovery by Dr Birger Bohlin, working in conjunction with the Chinese geologists Dr. C C Young and Mr W. C. Pei, of fragments of two jaws in association with pieces of brain cases, and the evidence confirmed the validity of the genus founded on the basis of the tooth in 1927.

The importance of the work accomplished during the two years covered by the first appropriation of the Rockefeller Foundation led in 1929 to the renewal of the grant and the creation of a special department, the Cenozoic Research Laboratory of the Geological Survey of China, under the honorary directorship of Prof Davidson Black This significant action was due in large measure to the support of Mr. Roger Greene, the executive head of the Peking Union Medical College, of which Dr. Black was professor of anatomy The work of developing these fossils was carried out by Davidson Black himself with superb technical skill. Not only did he clean the fossils and photograph them himself, but also he made the excellent casts which have enabled workers in Europe, who could not see the fossils themselves, to form a very exact idea of their nature. The attainment of these successful results implied a very happy spirit of friendship in the team of workers who undertook the various tasks, and called for all the unselfishness and spirit of conciliation which were so conspicuous in Dr Davidson Black, and without which the spirit of harmonious co-operation would have been impossible. He was always very jealous of the honour of his collaborators, especially of the Chinese geologists. When, in 1929, the Geological Society of China created the Grabau Gold Medal to be awarded for distinguished work, and recommended him for the first award, he protested that it should go to Dr Grabau's pupil Pei, who had made the great discoveries. Greatly as he appreciated the distinction, which was made doubly attractive by being associated with his old friend and master Grabau, he felt very strongly that the leader of the field work who had found the fossils would be the more appropriate recipient. The Society, however, wisely thought better, and solved the difficulty by awarding another gold medal to Mr Pei. This incident, however, was typical of his attitude towards all his Chinese colleagues, and explains a great deal of the conspicuous success of the Cenozoic Laboratory.

Dr Davidson Black's genius for friendship really lies at the back of the great work he has been carrying on. He was a man of charming personality, of great generosity and modesty. He was as enterprising and resourceful in superintending a children's party as he was in directing the excavations at Chou Kou Tien. It was a source of intense satisfaction to him when he was invited by the Royal Society to deliver the Croonian Lecture in 1932. It was not so much any pride in receiving this high distinction, as the opportunity it gave him to describe the work in Peking in his own restrained and careful way and particularly the opportunity it offered of making adequate acknowledgment of the help he had received from others, in particular his colleagues in Peking, and when in the following year he was elected to the fellowship of the Royal Society he received this distinction with the same modesty. These genial qualities earned him the friendship of a wide circle of people of all nationalities in Peking, who are now mourning their great loss.

Prof Davidson Black's methods of work were peculiar in many respects. All his serious work was done at night time for the sake of the quiet and the freedom from disturbance which it brought. He was fortunate in having the complete confidence and support of the Rockefeller Foundation of New York, which fully realised its great good fortune in having in its service so conspicuously competent a man. With its backing, Davidson Black was looking forward to a long life time of investigation. On his way to England two years ago to deliver his Croonian lecture, he made an extended reconnaissance in India, Persia, Western Asia and Egypt to discover likely sites on which to carry out excavations for fossils of men and apes, and for several years he has lived in the hope of exploring the Sinkiang Province of Chinese Turkestan, in the conviction that he would there find fossil apes more nearly akin to man than anything that is yet known. In fact his life was devoted to the study of Central Asia, in the hope that the geographical knowledge he acquired would prove of use to him for realising his hopes. He always kept by his bedside the lives of Genghis Khan and Tamerlane written a few years ago by Harold Lamb. By saturating himself with these works he felt he was becoming acquainted with the part of the world in which his chief hopes were centred.

In taking farewell of Davidson Black one regrets not only the loss of a friend of particular charm and generosity, but also the cutting short of the brilliant work in which he was engaged, and which there is no one else competent to complete.

G. ELLIOT SMITH

Prof D M Y Sommerville

DUNCAN MCLAREN YOUNG SOMMERVILLE was born in 1879 in Rajputana, and died on January 31, 1934, in New Zealand. After receiving an early education at Perth Academy he went to the University of St Andrews, where his mathematical and scientific ability soon became apparent. In 1905 he was appointed lecturer in the Mathematics Department at St Andrews, a post which he filled until 1915, when he became professor of pure and applied mathematics in Victoria University College, Wellington, New Zealand.

While Sommerville was essentially a geometer he had considerable interests in other sciences, and it is noteworthy that the classes which he chose to attend in his fourth year of study at St Andrews had been in anatomy and chemistry. Crystallography in particular appealed to him, and doubtless these possible outlets influenced his geometrical concepts and led Sommerville to ponder over space filling figures and gave an early impetus to thoughts in a field which he made peculiarly his own. Beneath his outward shyness considerable talents lay concealed: his intellectual grasp of geometry was balanced by a deftness in making models, and on the æsthetic side by an undoubted talent with the brush. In the course of years he produced a pleasing collection of water colour sketches of New Zealand scenery.

Sommerville's mathematical work falls naturally into two parts: that of the teacher and that of the original investigator. His textbooks, which have appeared at regular intervals, are a valuable link between the old and the new era in the teaching of geometry at college. They are the "Elements of Non-Euclidean Geometry" (1914), "Analytical Conics" (1924), "Introduction to the Geometry of *n* Dimensions" (1929), and the recent "Three Dimensional Geometry" (1934), the appearance of which he did not live to see. All are characterised by a variety of algebraic treatment and a wealth of illustrations and examples, but nowhere does technical manipulation outrun the geometry The first of these, a provocative little book, appeared at a time when metrical systems alternative to that of Euclid were known only to the few It is not surprising that such a teacher carried throughout his life the esteem and appreciation of his students One of his most distinguished pupils, A C Aitken, writes of the critical time in his own student days when the University of Otago was temporarily without a professor of mathematics, and how willingly Sommerville filled the gap by weekly correspondence The written solutions and comments went far beyond what was necessary for mere elucidation

Beginning in 1905, Sommerville wrote more than thirty original papers and notes which have been published in well known journals at home and abroad The first, entitled "Networks of the Plane in Absolute Geometry" (*Proc Roy Soc Edinburgh*, 25) is typical of the sequel The main theme is that of combinatory geometry, exemplified by a systematic investigation of "The Division of Space by Congruent Triangles and Tetrahedra" (1923) in the same journal and extended to *n* dimensions (Palermo 48, 9–22, 1924) Out of this grew the work upon the relations connecting angle sum and the volume of a polytope in space of *n* dimensions (*Proc Roy Soc London*, 1927)

Sommerville was ever ready to apply his special gifts to unusual examples, as in his analysis of preferential voting and a highly original treatment of the musical scale He was also much interested in astronomy, and was one of the founders of the New Zealand Astronomical Society and its first secretary At the Adelaide meeting of the Australasian Association for the Advancement of Science held in 1924 he was president of Section A His was a life of unsparing activity, and the fruits of his work will abide There has passed from Scotland one who had already become her leading geometer of the present century

H W TURNBULL

WE regret to announce the following deaths

Dr James Mackintosh Bell, O B E, formerly of the Canadian Geological Survey and in 1905–1911 director of the Geological Survey of New Zealand, on March 31, aged fifty six years

Dr James Munsie Bell, dean of the School of Applied Science in the University of North Carolina, who has carried out important researches in physical chemistry on March 3, aged fifty three years

Prof Arthur Ranum, professor of mathematics at Cornell University, on February 28 aged sixty three years

News and Views

Caleb Whitefoord, F R S (1734–1810)

CALEB WHITEFOORD, friend of Benjamin Franklin in the hey-day of the latter's fame, was born in 1734, at Edinburgh (the exact date would seem to be unrecorded) Whitefoord was the natural son of Col Charles Whitefoord, himself the third son of Sir Adam Whitefoord, Bt, of the shire of Ayr He died on February 4, 1810, at his home in Argyle Street, in the vicinity of Soho, and was buried in Paddington Churchyard Graduating at the University of Edinburgh, Whitefoord sought London as the best field for the exercise of his varied gifts, chief among these being a faculty for satirical journalism Eventually there were few literary, scientific and political celebrities of his period outside his circle Intimacy with Franklin (they were then neighbours in Craven Street, Strand) led to the opinion that Whitefoord would make an eligible diplomatic agent for the purpose of assisting in the restoration of peace with America Accordingly, he became secretary to the Commission which concluded peace with the United States at Paris, in 1782 He was elected a fellow of the Royal Society on June 24, 1784, when Sir Joseph Banks was president A fellow of the Royal Society of Edinburgh, and of the Society of Antiquaries, London, he was a vice-president of the Society of Arts, and a member of the Philosophical Society of Philadelphia Whitefoord's portrait was painted by Sir Joshua Reynolds in the eventful year 1782, and hangs in the National Portrait Gallery, a mezzotint of this by S W Reynolds is prized A pleasing drawing (head and bust), by R Cosway, is reproduced in the *European Magazine* for 1810 In 1790 Whitefoord presented a fine portrait of Benjamin Franklin, by Joseph Wright, to the Royal Society Such interesting connexion with the Society is further emphasised by the circumstance that Whitefoord, with Count Rumford signed in 1801, the certificate of recommendation for the election of Warren Hastings

Industrial Research and the State

MR STANLEY BALDWIN, as Lord President of the Council, may be regarded as a Minister of Research, since he is responsible to Parliament for the Committee of the Privy Council for Scientific and Industrial Research He is keenly alive to the possibilities of scientific and industrial research, and this attitude marks the message he sent recently to the conference of industrial research associations, reference to which was made in NATURE of March 31, p 504 Mr Baldwin confirmed his promise on behalf of the Government in replying to a question in the House of Commons on March 27, when he said

"ABOUT two years ago, steps were taken by the Department of Scientific and Industrial Research to ascertain the views of the Councils of Research Associations connected with the Department on a proposal that powers should be obtained to require firms in an industry to contribute towards co-operative research where the large bulk of the industry was in favour of such a course. The result was unfavourable to the proposal. Evidence has, however, been received that there may have been some change of opinion in the interval and the Department propose to consult the Associations again on the subject. If it appears that there is now a consensus of opinion in favour of such a Bill and if it is the opinion that a levy for research would be found practicable in a sufficient number of cases and that advantage is likely to be taken fairly generally of the provisions of such a Bill, . the whole matter will receive sympathetic consideration by the Government."

THIS reply is encouraging, and has an important bearing on the investigations undertaken by a Joint Committee of the British Science Guild and Association of Scientific Workers as to whether the research associations should be financed by a levy on the industries concerned, or by a State grant for a limited number of years of a sum of money designed to form an endowed capital for research—such grants to be provided from the new revenue from tariffs, wireless licences or other sources

The Panda or Cat-Bear

THE arrival at the Gardens of the Zoological Society of London of three specimens of that rare and most interesting animal the panda, or 'cat-bear' (*Aelurus fulgens*), should form an addition of no small interest to those visiting the Gardens during the summer months The coloration of this animal is striking The fur is of a rich chestnut-red, with white markings on the head, and black rings round the conspicuously long tail, while the under parts are almost black instead of the normal white. Though strictly speaking a carnivore, it is nevertheless almost omnivorous For while small mammals and birds, eggs, insects and their larvæ form their principal diet, they also feed largely on fruit and many kinds of shoots, especially of the bamboo, of which they are said to be very fond. Having regard to their typically carnivorous dentition, this very mixed diet is noteworthy

THE present geographical distribution of the panda is restricted to the Himalayas from Nepal to Yunnan, at an elevation of 6,000–11,000 ft, where they haunt trees or hide among boulders as circumstances determine, emerging in the early morning and evening to forage for food. Not much is known of their habits, as may be imagined from their almost inaccessible haunts, but observations on captive specimens have revealed some interesting facts, especially in regard to their mode of sleeping. Thus at times they will curl up like a cat, turning the long tail over the head; and at times they are said to sleep standing, with the head turned downwards between the forelegs after the manner of their near relations the racoons. When excited they emit a strong odour of musk. The panda is evidently a species which is dying out, for its range in past times was vastly greater. This much is shown by the fact that a panda one and a half times larger than the existing species has been found in the English Pliocene. No fossil remains of pandas have yet been found in America. But having regard to its very near kinship with the racoons, they may yet be found.

Cane-Rats

ANOTHER addition to the Zoo worthy of note is three young cane-rats (*Aulacodus swinderianus*) from West Africa These animals attain a considerable size when adult, the body measuring nearly two feet in length, exclusive of the tail, and weigh as much as 10 lb They range from the Sudan to the Cape, and up the west coast as far as Sierra Leone. The fur is conspicuously bristly, speckled with yellow and brown. The incisor teeth are of great size and very powerful. The upper pair are marked by three vertical grooves, sufficiently deep to leave their mark on anything gnawed by those animals. They feed on roots and shoots, and sugar-cane where it is to be had.

Archæological Studies in Peru

IT would appear that the celebration, or rather the 'commemoration', to use the term preferred locally, of the fourth centenary of the Spanish capture of Cuzco, the capital of the Inca empire of Peru, has given rise to a wave of popular enthusiasm for archæology which has taken the practical form of a vote of £30,000 (according to a dispatch in the *Times* of March 27) to be expended on, *inter alia*, the establishment of an archæological institute for the study and display of Peruvian antiquities and on archæological exploration and research. Already substantial discoveries have been made in the excavation of Sachsahuaman, a site near Cuzco, where hundreds of workmen are engaged in uncovering the walls, buildings, conduits, etc, in beautifully hewn stone of this once important fortress, which has been pronounced to be the "most wonderful achievement of ancient man in the two Americas" Excavations have also been begun at Tambo-machal and Pisac, and are in contemplation at Ollantaytambo and Macchu Picchu, the last stronghold of Inca power These operations are under the supervision of the Director General of the National Museum and are being conducted in accordance with the principles of scientific archæological research. Even at this early stage, attention has been directed to the problem of pre-Inca civilisation and the opportunities which it offers for investigation. Happily the foundations for its study on scientific lines have been laid down by the work of Prof. Max Uhle and others, and if funds which hitherto have been lacking for extended exploration are now to be available, many vexed and obscure problems of Central and South American archæology will come under review. The presence of a number of distinguished archæologists in Peru during the celebrations, which began on March 23 and will go on until July 18, will no doubt guide, as well as stimulate, local effort, which is inspired by motives not entirely unmixed. Even in Peru, archæology is not immune from the spur of over-enthusiastic nationalism.

Anthropological Studies in India

IN view of the important part which will be played by racial, religious and social questions in relation to administration and government in the India of the future, considerable interest is attached to a brief survey of the work in anthropology which has been, and is now being, done in India by Rai Bahadur L K Ananthakrishna Iyer, chairman of the Board of Higher Studies in Anthropology of the University of Calcutta and the author of a number of well known works on Indian anthropology, which appears in *Current Science* of January 1934 He points out that it is only in the last fifteen years that the vast mass of anthropological material offered by India has begun to be utilised systematically The School of Anthropology in the University of Calcutta was organised in 1921, and the University is now unique in prescribing the subject for the M A and M Sc examinations The students also have the advantage of an annual course of practical instruction in the field in various parts of Bengal and Chota Nagpur when both anthropometry and cultural anthropology are studied

THE anthropological work of the University is supplemented in Calcutta by that of the Indian Museum, where there is a well equipped laboratory, and research work is also carried on Much of this research has already been embodied in important monographs Reference is also made to the work of Dr J H Hutton in Assam and to that of Sarat Chandra Roy editor of Man in India On the west coast the only institution concerned with anthropology is the Anthropological Society of Bombay , and the author expresses regret that Madras with one old and two infant universities, has taken so little advantage of its opportunities for anthropological research In Mysore, the University has revived the Ethnographic Survey of the State and the fourth and final volume of its report is now in preparation for publication The work of the Indian Science Congress is also noted The author concludes by deploring the fact that while there are many regions in India unexplored anthropologically the workers are few He urges that a band of young men should be trained to collect material in these unexplored fields

Agricultural Education in New Zealand

AGRICULTURAL research in New Zealand has a staunch friend in the Governor General, Lord Bledisloe, who, having a lifelong acquaintance with British agriculture, is peculiarly fitted to estimate the value to the farming community of such agencies as the New Zealand Department of Scientific and Industrial Research and the Cawthron Institute In a recent address to the students of Wellington College, New Zealand, on the new needs of education, he referred to the appointment of a former student, Theodore Rigg, to the directorship of the Institute, "an organization notable throughout the Empire for the thoroughness, accuracy, and economic value of its agricultural researches" Touching on the question of the careers for which a college training offers a suitable preparation, he stressed the claims of the rural population of a Dominion in which farming is the greatest industry to leadership such as a college graduate might aspire to He added point to his observations by revealing that it was considerations such as these which induced the Rhodes scholarship selection committee to select, for the first time in the history of the Trust, a young agricultural scientific worker for appointment to one of these scholarships

Investigations in the Stratosphere

THERE are now two bodies in Russia intent on surveying the scientific and other possibilities of the upper atmosphere They are the Society for Aviation and Chemical Warfare, with outside experts and with M Dubenski assistant director of the Military Aviation Academy, as chairman of the commission, and a more civilian type of composite body drawn from the Leningrad Institute of Aerology the Radio Institute and the Central Geophysical Laboratory The former organisation was responsible for the successful flight of *Stratostat USSR* piloted by M Prokofiev last September as well as that ending in disaster on January 30 this year If one can judge from the reports from Russian newspapers these two schools are sharply divided on the question of manned and unmanned balloons respectively The military organisation, the programme of which is the study of ultra violet solar radiation and atomic disintegration by cosmic rays is concentrating its attention on shock absorbers gliders parachutes, etc , in order to safeguard future crews from disaster The civil body however is specialising upon further improvements in automatic registering devices to be attached to balloonets after the manner of Regener's whose work with these down to a pressure of 22 mm (about 28 kilometres up) has not yet been superseded The new device consists of a string of two or three such elastic balloonets each about 2 metres in diameter on the ground, filled with hydrogen for carrying the self recording devices A trial has already been made with one such balloonet This reached a maximum altitude of 18 6 kilometres and was followed during its ascent by theodolite observations It automatically transmitted radio signals of pressure temperature and hygrometric data on a wave length of 25 metres Unfortunately the apparatus has been lost In a new apparatus which was to be ready by the end of March there were to be added cosmic ray intensity and gas analysis transmissions and a camera This work of the Institute of Aerology is a very laudable enterprise and the results will be awaited with interest

Sydney Harbour Bridge

AMONG the recently published abstracts of papers to be discussed by the Institution of Civil Engineers are four relating to the design, construction and calculations of the great arch bridge over the harbour at Sydney, New South Wales The papers, Nos 4904, 4922, 4923 and 4946, are by Mr R Freeman, Mr L Ennis, Mr J F Pain, Mr G Roberts and Dr J J C. Bradfield, and the discussion will be held on April 10

The bridge, which took a little more than eight years to complete, cost £4,248,000 It consists of a main span of 1,650 ft with a clearance of 170 ft over the central 300 ft of span, and ten approach spans It accommodates a roadway 57 ft wide, four railway tracks and two footways The principal parts of the main-span truss are of silicon steel with a modulus of elasticity of 30,500,000 lb per sq in Analytical methods of calculation were used, arithmetical processes being carried out by calculating machines Calculations were required for the following combinations of loads dead load, live load and impact, horizontal force, centrifugal force, wind loads and temperature variation Of the total weight of the main truss material, the proportions attributable to various loads are as follows dead weight of arch, 35 per cent, dead weight of deck, 23 per cent, live load and impact, 26 per cent, wind, 8 per cent, horizontal force, 2 per cent, and temperature, 6 per cent Tests on model members were made by means of a testing machine of 1,250 tons capacity, capable of dealing with tension and compression specimens up to 50 ft long and bend test specimens 20 ft long Tests of the arch after completion indicated a span ¾ in in excess of 1,650 ft, a difference partly due to unavoidable errors of survey and possibly partly caused by shrinkage of the concrete below the bearings The bridge was erected by Messrs Dorman, Long and Co, of Middlesborough

The *Indian Antiquary*

With the December issue, which, through labour troubles, has only just become available in Great Britain the *Indian Antiquary* ceases publication The demise of this valuable periodical will be greatly regretted by all who are interested in Indian studies For more than sixty years it has served as a medium of publication for original communications of the highest standard of scholarship, dealing with the ethnology, archæology, history, linguistics, folk lore and religions of India The *Indian Antiquary* was founded by the late Dr J Burgess in 1872 and later was acquired by the late Sir Richard Temple as his sole property Under his editorship—he was editor in chief for forty-six out of the fifty one years of his connexion with it—the services of the *Indian Antiquary* to the cultural history of India were incalculable Sir Richard Temple's wide knowledge of oriental subjects made him an ideal editor of a journal of this type, not merely because of his own numerous contributions to its pages, but also for the stimulus and assistance he was able to give to the studies of others As one result of his influence may be mentioned *Epigraphia Indica*, the official record of epigraphic work in India, which was a direct outgrowth of work initiated by the *Indian Antiquary* In 1924 Sir Richard Temple transferred his interest in the journal to a small private company, and the Royal Anthropological Institute assumed responsibility for its publication Sir Richard Temple retained the editorship, at first in association with Mr S M Edwardes, and after his death in 1927 with Mr C E A W Oldham, who became editor in-chief on Sir Richard's death in 1931 Owing to financial conditions the Royal Anthropological Institute felt compelled to sever its connexion with the *Indian Antiquary* in 1932 and during the past year it has been carried on by the editor in order to complete publication of matter in hand

Protection of Power-Transmission Plant from Lightning

A series of articles on lightning by J F. Shipley which is being reprinted in *Distribution of Electricity*, a paper published by W. T Henley's Telegraph Works Co, gives a résumé of what has been accomplished in recent years in protecting transmission lines and engineering plant connected with them from damage from lightning The effect of a lightning flash on a transmission line is to puncture the insulators or make them flash over, sometimes causing a short circuit which shuts down the supply During the last forty years a very large number of devices have been employed to protect the lines, such as air gaps, water jets, oxide films, etc These have been found only partially effective The ideal arrester would be some link between the line and earth which would have infinite resistance at the normal pressure, but when for any reason that pressure increased by 10 or 20 per cent, the resistance should become practically zero, thus furnishing the impulsive rush of electricity with a safe path to earth A recent device consists of a solid block of a material consisting of conducting particles of metallic oxide diffused in a baked clay which is microscopically porous It is similar to porcelain in texture and mechanical strength and normally has almost infinite resistance As soon as the electrical pressure across a block of it rises above a definite value its resistance decreases at a very rapid rate If we double the voltage, the current it will pass increases more than twelve times The material seems to have two names, 'thyrite' and 'ocelit' As it is an artificial product and can be accurately controlled, it looks as if a real step forward has been made in the design of these arresters, or 'safety valves' as they are often called

Electric Waxing of Floors

Helios, a German electrical trade journal printed in Leipzig, gives descriptions in three parallel columns in German, French and English respectively of the latest electrical devices In the issue for November 19 an interesting description is given of tests on an electric floor waxing device, with and without a suction apparatus for the simultaneous collection of dust The tests were carried out in the laboratories of several universities as well as in commercial test rooms When the suction device was used there was no appreciable change in the percentage of dust in the air caused by the whirling of the waxing apparatus When no suction device was employed the percentage of dust in the air increased as much as seven to eight times the normal quantity In this case the dust on the floor was whirled upwards by the waxing machine With the suction device it is not necessary to clean the room so often and there is no need to have a special vacuum cleaner. The dust which settles on furniture prolongs the work of cleaning, and certain works of art are damaged, while it is also a menace to health In many workshops the dust impairs the quality of the finished goods The floor waxing machine with suction device should prove specially useful in hotels, hospitals and sanatoriums

Industrial Physics

THE address which Dr Paul D Foote delivered before the American Physical Society as retiring president appears in full in the February issue of the *Review of Scientific Instruments* In it he points out how inadequately industrial physics has been represented on the Council of the Society, and how as a consequence much of the work of the members of the Society has failed to attract the attention of industrial executives and they are unable to see that there are places for physicists in their organisations It has been left to large corporations like the General Electric Company to show how much physicists can do for industry Dr Foote considers that the training in physics in most of the American universities fits a man neither for industry nor for a position in a junior college, and that industry has to look to the engineering rather than to the physics departments for men adequately trained in the fundamentals of classical physics in preference to those superficially acquainted with the latest developments of quantum mechanics He hopes that the newly formed American Institute of Physics and the new journal *Physics* will secure more intimate contact between physics and industry, and that the attitude of the Society towards applied physics in the next few years will insure that physics becomes a real profession rather than an academic avocation Since the foundation of the Institute of Physics, in London in 1918, the position of British physicists has improved Lord Rutherford recently pointed out that there has been a rapidly growing recognition of the importance of the physicist, not only in the academic world but also in industry, and he considers that the Institute of Physics can justly claim some of the credit for this

Tests for Accident Proneness

UNDER the title 'Tests for Accident Proneness', the Industrial Health Research Board has published the results of a further investigation into the factors involved in 'accident proneness" which have engaged its attention for several years (Medical Research Council Industrial Health Research Board Report No 68 Tests for Accident Proneness Pp iv+37 London: H.M Stationery Office, 1933. 9d net) Previous work had established that certain individuals are inherently more liable to sustain industrial accidents than others exposed to the same risk By the investigations of E Farmer, E G Chambers and F J Kirk now reported, it has been established from experiments with groups of dockyard apprentices and naval artificers that, within the groups studied, poor æsthetokinetic co ordination (defined as the ability to do certain sensori motor tests) is associated with a liability to sustain an undue number of accidents The results do not suggest that æsthetokinetic co ordination is associated with accident proneness in all occupations, although it is probably associated with it in groups doing similar work to those tested Deficiency in this function, however, only accounted for a part of the accidents sustained, and it is evident that only one of the factors involved in accident proneness has thus far been isolated and evaluated Even this, however, makes a definite step towards the practical goal of detecting beforehand those specially liable to accident and warning them against entering dangerous occupations No significant relation was observed between intelligence and accidents in any of the groups, and in two of them accident proneness did not decrease with age and experience It does not follow, however that in groups employed on different work, variations in intelligence may not play a part in accident proneness

Scientific Survey of South-Eastern Polynesia

THE Bernice P Bishop Museum, Honolulu, has organised an expedition, to be known as the Mangareva Expedition, for the study of the little known parts of south eastern Polynesia Because other means of transportation are unavailable, the Expedition is provided with two ships The *Islander* (Capt W G Anderson), a high powered sampan, was to leave Honolulu on March 1 and during a six months cruise will serve as a master ship' for scientific workers who will conduct investigations chiefly at Mangareva, Oeno, Pitcairn, Rapa, Tubuai, Rurutu, Raivavae, and Rimitara islands The second ship, the cutter yacht *Tiare Tahiti* (Capt Robert S Burrell), under charter from May until October, will serve primarily as a transfer ship' for the ethnologists at work in Mangareva and among the three hundred and sixty islands of the Tuamotu Archipelago The chief purpose of the Expedition is to record the data regarding native races, flora and land fauna, which are disappearing at a surprisingly rapid rate Incidental observations on geology, marine zoology and general oceanography will also be made The scientific staff includes Dr Peter H Buck, Kenneth P Emory and J Frank Stimson, ethnologists, Prof Harold St John and Raymond Fosberg, botanists, Dr C Montague Cooke, Jr, and Donald Anderson, malacologists, and E C Zimmerman, field entomologist Dr C Montague Cooke, Jr, has been appointed leader of the Expedition

A History of Vegetables

THE *Gardeners' Chronicle* of March 3 publishes a report of a lecture on "The Introduction of Vegetables" by Mr E A Bunyard It comes as somewhat of a surprise to find that many of our common vegetables were once regarded as harmful plants, or were the subjects of religious prohibition The broad bean, for example, was forbidden to the Egyptian priests, though later it was the cause of 'bean feasts' to a bean god Garlic, cabbage, asparagus and spinach have all had a somewhat chequered history The scarlet runner bean was long prevented from becoming a table delicacy by its value for ornamental purposes Tomatoes were first suspected of being poisonous, then became medicinal, and it was not until the 'eighties of last century that their nutritive value was realised in Great Britain. The potato survived a great volume of scorn, and was finally introduced to cultivation through sheer necessity—it mitigated the hardships of several famines. Mr. Bunyard suggests, somewhat whimsically, that lilies and tulips are edible, and appeals for an extension of "the Elizabethan spirit of adventure in the vegetable garden".

Sir Henry Wellcome, F.R.S.

THE President of the French Republic has paid a notable tribute to English medical and chemical research by conferring the honour of La Croix de Chevalier de la Légion d'Honneur upon Sir Henry Wellcome, who has also just been awarded the Remington medal of the American Pharmaceutical Association for distinguished service to pharmacy. Sir Henry is founder of the Wellcome Research Institution and head of Burroughs Wellcome and Co., London, manufacturers of fine chemicals and galenicals, with establishments in the United States, Italy, Canada, Australia, India, China, South Africa, the Argentine and other countries. Apart from the research and experimental laboratories of the establishments of Burroughs Wellcome and Co. which have carried out many original researches in pharmacy, Sir Henry Wellcome has established a number of scientific research laboratories and research museums which are co-ordinated under separate and distinct direction, such as the Wellcome Research Institution with its magnificent new building in Euston Road, London. In these associated chemical and medical research laboratories and museums, much original work has been done to throw light on abstruse problems in medicine and pharmacy and to settle hitherto uncertain points in the history of pharmacy.

Royal Irish Academy

AT the stated meeting on March 16 of the Royal Irish Academy, the following members were elected: Prof. K. G. Emeléus, professor of physics, Queen's University of Belfast; Prof. T. T. Flynn, professor of zoology, Queen's University of Belfast; Dr. R. H. Hunter, senior lecturer in anatomy, Queen's University of Belfast; Rev. J. Hynes, professor of archæology, University College, Galway; Rev. G. V. Jourdan, professor of ecclesiastical history, University of Dublin; Prof. M. F. Liddell, professor of German, University of Dublin; Mr. C. Blake Whelan, archæologist. The Abbé Victor Grégoire has been elected an honorary member in the Department of Science and Prof. Ellis H. Minns, Prof. Michael Rostovtzeff and Prof. Jean B. Vendryes honorary members in the Department of Polite Literature and Antiquities.

Announcements

THE first Royal Society soirée this year will be held in the Society's rooms at Burlington House on May 9 and the second on June 20.

PROF. A. M. CARR-SAUNDERS, Charles Booth professor of social science, University of Liverpool, has been elected a member of the Athenæum under the provisions of Rule II of the club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts or for public service.

PROF. H. LEVY, professor of mathematics at the Imperial College of Science, will deliver the twenty-fifth Conway Memorial Lecture on Wednesday, April 25, at 7 p.m. at Conway Hall, Red Lion Square, W.C.1, his subject being "Science in an Irrational Society". Admission will be free.

THE Academy of Sciences of the U.S.S.R. has elected the following to honorary membership of the Society: Sir Frederick Gowland Hopkins, Cambridge; Prof. G. H. Hardy, Cambridge; Dr. E. Schrödinger, Berlin (now Oxford); Prof. David Hilbert, Göttingen; Prof. Max Born, Göttingen (now Cambridge); Prof. T. Levi-Civita, Rome; and Prof. Carl Størmer, Oslo. Prof. Vaino Tanner, Helsingfors, has been elected a corresponding member.

THE Hillebrand Prize of the Chemical Society of Washington for the year 1933 has been awarded to the late Dr. Edward Wight Washburn for the discovery of the first practical method of separating the isotopes of hydrogen. He discovered the electrolytic method of separation, which has made possible the subsequent research into the properties of the isotopes of hydrogen, and has thus initiated almost a new era in chemistry, consequent upon the differences in the chemical and physical properties of these isotopes and their compounds.

THE Council of the Iron and Steel Institute announces that His Majesty the King has been graciously pleased to accept the Bessemer Gold Medal of the Institute for 1934. His Majesty has been the patron of the Iron and Steel Institute since his accession. The Bessemer Gold Medal was founded in 1873 by the late Sir (then Mr.) Henry Bessemer, the discoverer of the Bessemer process of steel-making and the second president of the Iron and Steel Institute. It has been awarded annually since that date to distinguished benefactors of the industry and particularly for pre-eminent contributions towards the scientific and technical knowledge of iron and steel. In 1899 Queen Victoria, and in 1906 King Edward VII, agreed to be recipients of this Medal.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A general manager for the Pigs Marketing Board—The Secretary, Pigs Marketing Board, Thames House, Millbank, London, S.W.1 (April 9). A public analyst for the Dorset County Council—The Clerk of the County Council, County Offices, Dorchester (April 18). A teacher of mathematics, and a teacher of applied mechanics and machine drawing, at the Junior Technical School, Sheffield—The Chief Education Officer, Leopold Street, Sheffield (April 19). A senior assistant librarian at University College, Hull—The Registrar (April 20). A temporary resident lecturer (woman) in history and geography at the Hereford Training College—The Principal.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return nor to correspond with the writers of rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Behaviour of Condensed Helium near Absolute Zero

THE recently published measurements[1] on some properties of condensed helium in conjunction with the facts known from the work of Keesom and his co workers[2] allow us to draw some conclusions on the behaviour of helium at very low temperatures

It has already been shown by Keesom who found the melting pressure to become nearly independent of temperature that the entropy difference between the two phases tends towards zero with falling temperature (Nernst s theorem)[3] This means that the liquid phase has to go into an ordered state[4] This change takes place at the λ point and is associated with a large loss of energy which though continuous occurs in a relatively small temperature range (One cannot say yet in which way this ordered state—called once by the author liquid degeneration —is realised Keesom[5] who recently published very similar considerations calls it a quasi crystalline state Clusius[6] also speaks of a crystalline state and adds the more specialised assumption of an association starting in the λ region)

Since the entropy difference vanishes the heat of fusion (ρ $T\Delta S = \Delta U + p\Delta V$) must tend towards zero *a fortiori*[7] This can be realised in two possible ways (1) both ΔU and $p\Delta V$ may become zero and this could scarcely be interpreted in any other way than that both phases become identical (The same would happen if the temperature coefficient of the melting pressure were not to disappear completely) (2) ΔU and $p\Delta V$ become equal but of opposite sign that is (*a*) ΔU or (*b*) ΔV changes its sign Our measurements now enable us to find both components of ρ and to extrapolate their values to absolute zero Although such an extrapolation entails some uncertainty we think it accurate enough to draw the following conclusions

One finds that along the melting curve the volume of the liquid remains always higher than that of the solid the volume difference even increases appreciably with falling temperature The energy of the liquid at 4° is greater than that of the solid just as with the normal liquid At about 2 5° however the energy difference begins to fall rapidly passes zero a little below 2° and approaches finally a value of about − 2 cal /gm atom This would mean that the possibility 2 (*a*) is realised

Thus the energy of the liquid at very low temperatures is smaller than that of the solid contrary to the normal Compressing the liquid to the solid one has to do work against the repulsive forces this work being greater than that done by the attractive forces Now arises the question of the origin of these strong repulsive forces for at the interatomic distances realised in liquid helium there can be no appreciable repulsion originating in the atomic fields every atom in the liquid having at its disposal a cube of 3 6 A length compared with the gas kinetic diameter of about 1 9 A

In order to understand this we have to consider the part played by the zero point energy Extrapolation of the measured latent heats of evaporation[8] to absolute zero gives an energy difference between the liquid without external pressure and the gas of about 14 cal From our data it then follows that the corresponding values for the liquid and the solid under the equilibrium pressure are 13 cal and 11 cal respectively Now the zero point energy of the solid under equilibrium pressure has a value of about 60 cal so that the lattice energy originating in the interatomic forces would amount to about 70 cal Thus we see that the zero point energy compensates by far the greater part of the lattice energy and therefore it must be the chief factor in the behaviour of the substance Having made a first estimate of the magnitude of the zero point energy from the deviations from Trouton s rule we have previously emphasised[9] that its large value probably is the explanation for helium remaining liquid The attractive forces cannot diminish the volume until they are compensated by the atomic repulsive forces the helium cannot crystallise with the normal volume but has to take up a bigger volume with corresponding smaller zero point energy[10] Only high external pressure can compress it into the close packed crystalline state

With diminishing volume the zero point energy must increase So on compressing one has to do work in order to increase the zero point energy and this is equivalent in many respects to the existence of a repulsive force At the interatomic distances realised in the liquid this greatly exceeds the repulsive forces resulting from the atomic fields and the most important factor in the compressibility is due to this

Before going into further details especially for explaining the negative coefficient of expansion below the λ point it seems necessary to have more specialised ideas on the structure of the liquid and to make assumptions for the way in which it passes into the ordered state It may be possible that the expansion coefficient will become normal again at lower temperatures and that the negative value in the λ region is of merely local character For this reason we will await the result of investigations at very low temperatures which are now in progress before going into further discussion

F SIMON

Clarendon Laboratory
Oxford
March 1

[1] R Kalschew and F Simon NATURE, 133 460 March 24, 1934

[2] *Leid Comm* No 184*b* 190*b* 216*b* 219*c* 221*e* *Physica* 1, 125 161, 1934

[3] *Leid Comm* Suppl 61*b*

[4] F Simon *Z Phys* 41 806 1927 *Erg ex Naturw* 9 235 247ff 1930 *Z anorg Chem* 203 222 1931

[5] *Leid Comm* Suppl 71*e*

[6] Paper read in Breslau 1933 unpublished

See also the measurements at higher temperatures made with Steckel, *Z phys Chem*, Bodensteinband 737 1931

[8] L I Dana and H Kamerlingh Onnes *Leid Comm* 179*c*

[9] K Bennewitz and F Simon *Z Phys*, 16 183, 1923

[10] Compare also K Wohl *Z phys Chem* B 2, 104 1929

Wave Mechanics and Structural Chemistry

THE modern applications of wave mechanics to molecular structure and in particular the method of molecular orbitals developed by Mulliken and Lennard Jones have shown that it is not expedient to treat the individual links between atoms separately, and that the electrons in the molecule must be treated as a whole The organic chemist on the other hand, regards the molecule as held together by links from atom to atom, and the only distinction in kind which he recognises among links is into single, double and triple, and his method of representation is found to be capable of providing different formulæ for every experimentally distinct chemical substance, indeed it sometimes provides two formulæ for one substance, as with inseparable tautomers

If these views are both true, it follows that if a molecule with one structural formula can have (in the sense of the molecular orbital theory) more than one electronic constitution, these must be able to change into one another in less time than is required to isolate the substance, which involves a half life period of not more than a second or so, and a correspondingly minute heat of activation

Now on the theory of reaction proposed by London and Villars, and developed in detail by Eyring and Polanyi, the heat of activation of a chemical reaction is mainly the work needed to bring the atoms to those distances from one another which are required for their re grouping into the products of the reaction If this is so, an isomeric (tautomeric) reaction in which the atoms have nearly the same relative positions after as before, would have a very small heat of activation and would occur with great rapidity This seems to provide a reconciliation between the conclusions of wave mechanics and those of structural chemistry The atoms of a molecule may have one or more dispositions in space The number of these is the number of isomeric formulæ provided by the structural theory Only this number of forms can be isolated, because it is only between them that the rate of interconversion is slow Any finer modifications of the electron distribution which wave mechanics can detect must involve nearly the same positions of the atoms in space, and hence cannot lead to new isomers, as these would change into one another too rapidly We already know instances in which two structural formulæ give practically the same atomic positions, as in the Kekulé benzene formula, and then it is always found that the expected isomers are identical

It should be possible to define more precisely what is meant by nearly' the same positions We have evidence that the difference in length between a single and a double link, or in angle between the 109 5° of $\mathrm{X{-}X}\underset{\mathrm{X}}{\diagdown}$ and the 125° of $\mathrm{X{=}X}\underset{\mathrm{X}}{\diagdown}$ can be regarded as negligible from this point of view But we must expect a considerable range of differences corresponding to the wide range in rates of conversion, from those tautomers which can be separated at low temperatures to those which change into one another at a rate too great to be observed by any known method

N V Sidgwick

Lincoln College, Oxford
March 14

Activities of Life and the Second Law of Thermodynamics

In a recent letter in Nature[1] Sir James Jeans, in replying to a criticism made by one of us[2], writes "Given perfectly level and frictionless railways, a man may move millions of tons of matter, and thereby decrease the entropy of the world enormously, without incurring any corresponding increase of entropy through the combustion of food or fuel" Not only can this surprising statement be disproved, but the very reverse of it can be readily demonstrated. The entropy decrease associated with the sorting out of trucks depends not on the number of tons but on the number of trucks Its magnitude would be the same if the trucks were replaced by an equal number of miniature trucks or counters or molecules If a man were to sort out a million trucks, the entropy decrease would be of the same order of magnitude (to within a few powers of ten) as the increase of entropy when he breathes a million molecules of oxygen To complete the proof of our assertion it is only necessary to estimate roughly how long it would take a man to sort out a million trucks and then estimate how many millions of millions of millions of millions of molecules of oxygen he must have breathed while he was doing it

The same letter contains the statement "We cannot, for example, suppose that the man who steers the *Mauretania* consumes food energy at a rate comparable with 100,000 h p more than normal" Indeed, no one with a knowledge of thermodynamics would suppose so The entropy associated with the steering of the *Mauretania* is of the order of magnitude of Boltzmann's constant k, simply because there is only one *Mauretania* being steered In thermodynamic parlance, the difference between the total energy and the free energy associated with the motion of the centre of mass of the *Mauretania* is of the order of magnitude kT where T is the absolute temperature, and this quantity is some 10^{30} times smaller than the kinetic energy of the ship The same thing may be expressed by saying that the Brownian movement of the *Mauretania* is negligible in comparison with its directed motion

In view of Sir James's lapse in thermodynamic reasoning we consider it not unreasonable to challenge his vague reference to orthodox physiology', and ask on what experimental evidence he relies for his statement concerning entropy changes in the brain

F G Donnan
E A Guggenheim

University College, London, and
University of Reading
March 15

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[1] Nature 133 174 Feb 3 1934

[2] Nature 133 99 Jan 20 1934

Induced Radioactivity of the Lighter Elements

We have been investigating the phenomenon of induced radioactivity in aluminium, boron and magnesium recently reported by Curie and Joliot[1], and have been able fully to confirm their observations, and also to add further details Using radium C′ α particles reduced in range to 6 1 cm, we find the relative yields of positrons during the entire decay from aluminium, boron and magnesium to be approximately 30, 10 and 7 Since the periods are respectively 3¼, 14 and 2½ minutes, the initial effects are in the ratio 6, 0 5, 2 With all materials we find an effect with a period of about 1 minute and of initial activity comparable with that of boron This must be due to some impurity which is always present, such as carbon, nitrogen or oxygen

Taking into account the solid angles involved, it appears that the probability of a 7×10^6 volt α particle producing a radiophosphorus atom by impact on aluminium is about 1 in 5×10^6 The above relative values are of no great significance, since the yield varies rapidly with the energy of the α particle in a manner dependent on the shape of the potential barrier which of course is different in these three elements This variation has been measured in the case of aluminium and we find that the yield of positrons increases by a factor of 15 as the energy of the α particle is changed from 5 5 to 7 × 10^6 volts

Using thorium C α particles the measurements have been extended to 8 3 × 10^6 volts and the probability of excitation appears to be reaching a maximum here This is in agreement with the far more detailed results obtained by investigating the protons liberated from aluminium by α particles Our results are compatible with the view that an α particle colliding with an aluminium nucleus has a certain chance of being captured and that from this arises a phenomenon analogous to radioactive branching the two alternatives being presumably the immediate emission of either a proton or a neutron It is the latter emission which produces the radioactive isotope of phosphorus which emits positrons The branching ratio appears to be of the order of 50 to 1 in favour of the proton emission

While we have been able to detect the positrons from aluminium by magnetic focusing the numbers were not sufficient to give definite measurements of the distribution with velocity but we detected positrons over the range 1 million to at least 2½ million volts Measurements of the absorption in copper and aluminium showed as the most significant feature an initial flat portion of the curve Comparing these curves with those obtained with the same apparatus but using β particles of thorium (C+C″) leads us to think that there are very few if any positrons of low energy Practically all of the positrons are stopped by 1 2 gm /cm ^{2} of aluminium which in the case of β particles would correspond to an energy of about 2½ million volts

An interesting feature of these absorption curves is that radiation is detectable through several millimetres of lead Part of this γ radiation is presumably the radiation arising from the annihilation of the positrons

A full report of these experiments will be published shortly

C D ELLIS
W J HENDERSON

Cavendish Laboratory
Cambridge
March 26

NATURE 133 201 Feb 10 1934

Inner Conversion in X Ray Spectra

IN a recent communication[1] Saha and Mukerjie have pointed out that although the transition $L_{\text{II,III}} \rightarrow L_{\text{I}}$ is not forbidden by quantum mechanics the X ray spectral line corresponding to it has never been observed and they have suggested that the failure to obtain such a line can be ascribed to its complete internal conversion in the *M*-shell Such an explanation would appear however to be inconsistent with the conclusions reached by Taylor and Mott[2] in their recent discussion of the nature of the internal conversion process for γ rays (Clearly the same considerations will apply to the internal conversion of X rays) Briefly stated in terms of the present problem the conclusion reached is as follows the presence of the *M* electrons increases the number of $L_{\text{III}} \rightarrow L_{\text{I}}$ transitions above that to be expected from a direct calculation of the electric moment corresponding to such a transition the rate of production of such induced transitions being only slightly less than the rate of ejection of the *M* electrons and thus the intensity of the observed X ray line should be only slightly decreased by the internal conversion

It is evident then that the phenomenon of the *internal conversion of X rays (Auger effect) can have* little bearing on the departure of measured X ray line intensities from those calculated theoretically and the statement that any radiation is completely converted in an inner shell is meaningless

That the above considerations are in fact important in these problems has become evident from a theoretical investigation one of us (E H S B) is making of the Auger effect full details of which will be published in due course While not yet complete this investigation is sufficiently advanced to show that allowing for the presence of induced transitions the *K* series internal conversion coefficient (defined as the ratio of the number of Auger electrons to the total number of transitions to the *K* shell occurring per unit time) is given closely by the expression $(1 + bZ^4)^{-1}$ Z being the atomic number of the element considered and b a constant characteristic of the particular transition A relation of this type satisfactorily fits the experimental data (as collected by Martin[3]) on the variation of the internal conversion coefficient with atomic number If however there were no induced transitions the internal conversion coefficient would be proportional to Z^{-4} and there would then arise for elements of low atomic number the paradox that the number of Auger electrons emitted per unit time exceeds the total number of transitions

H M TAYLOR
E H S BURHOP

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March 14

[1] NATURE 133 377 March 10 1934
[2] Taylor and Mott, *Proc Roy Soc* A 142, 215 1933
[3] Martin *Proc Roy Soc* A 115, 420 1927

Nuclear Moments of the Antimony Isotopes

Badami[1] first reported the existence of complex fine structures in the visible lines of the Sb II spectrum As a source he used a relatively high current arc (3–5 amp) and to explain the structures he suggested that the nuclear spin of the isotope 121 is 5/2 and that of the 123 isotope is 7/2 (These are the only isotopes in antimony)

I have succeeded in producing a very brilliant Sb II spectrum in a hollow cathode using only one seventh of an ampere and as a result the lines are so very much sharper than those in the arc that the extremely complex patterns encountered are more completely resolved many lines showing more components than those reported by Badami The analysis of the line patterns shows without any doubt that the nuclear mechanical spins of both 121 and 123 are 5/2 but that the two isotopes have different nuclear magnetic moments in the ratio 1 36 1 the 121 isotope having the larger value This may be compared with the ratio 1 27 1 in gallium the only other known case which has two isotopes with identical spins (½) and different nuclear magnetic moments

The following comparison of the structure given by Badami and by me for the line λ 5639 7 ($6s$ ${}^3P_2 - 6p$ ${}^3S_1$) shows to what extent the hollow cathode patterns are more clearly resolved

Badami	0 (6)		205 (5)			450 (4)	584 (4)	760 (1)	cm	$\times 10^{-3}$
Tolansky	0 (10)	71 (8)	217 (9)	319 (3)	399 (3½)	477 (6)	606 (5)	728 (1½)	cm	$\times 10^{-3}$

It is seen that Badami s values are those which would arise from the blending of components due to excessive line width

Full details with analysis will be communicated elsewhere shortly

S Tolansky

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March 3

[1] J S Badami *Z Phys* 79 206 1932

The Neutrino

This view has recently been put forward[1] that a neutral particle of about electronic mass and spin $\frac{1}{2}\hbar$ (where $\hbar = h/2\pi$) exists and that this neutrino is emitted together with an electron in β-decay This assumption allows the conservation laws for energy and angular momentum to hold in nuclear physics[2] Both the emitted electron and neutrino could be described either (*a*) as having existed before in the nucleus or (*b*) as being created at the time of emission In a recent paper[3] Fermi has proposed a model of β disintegration using (*b*) which seems to be confirmed by experiment

According to (*a*) one should picture the neutron as being built up of a proton an electron and a neutrino while if one accepts (*b*) the rôles of neutron and proton would be symmetrical[4] and one would expect that positive electrons could also sometimes be created together with a neutrino in nuclear transformations Therefore the experiments of Curie and Joliot[5] on an artificial positive β decay give strong support to method (*b*) as one can scarcely assume the existence of positive electrons in the nucleus

Why then have positive electrons never been found in the natural β-decay ? This can be explained by the fact that radioactivity usually starts with α-emission and therefore leads to nuclei the charge of which is too small compared with their weight The artificial β emission was found for two unstable nuclei (most probably N^{13} and P^{30}) formed by capture of an α particle and emission of a neutron and therefore having too high a charge for their mass

A consequence of assumption (*b*) is that two isobares differing by 1 in atomic number can only be stable if the difference of their masses is less than the mass of electron and neutrino together For otherwise the heavier of the two elements would disintegrate with emission of a neutrino and either a positive or negative electron There will be only a limited region on the mass defect curve probably at medium atomic weight where such small differences are possible In fact neighbouring isobares have only been found with the mass numbers 87 115 121 123 (187) (203) while isobares with atomic numbers differing by 2 are very frequent In the first case one of the two nuclei (Rb) is known to emit β rays In each of the last two cases one of the two isobares is stated to be exceedingly rare and its identification might be due to experimental error The other three cases actually lie close together and have medium weight A particular case of isobares are proton and neutron Since all experimentally deduced values of the neutron mass lie between 1 0068 and 1 0078 they are certainly both stable even if the mass of the neutrino should be zero

The possibility of creating neutrinos necessarily implies the existence of annihilation processes The most interesting amongst them would be the following a neutrino hits a nucleus and a positive or negative electron is created while the neutrino disappears and the charge of the nucleus changes by 1

The cross section σ for such processes for a neutrino of given energy may be estimated from the lifetime *t* of β radiating nuclei giving neutrinos of the same energy (This estimate is in accord with Fermi s model but is more general) Dimensionally the connexion will be

$$\sigma \quad A/t$$

where *A* has the dimension cm^2 sec The longest length and time which can possibly be involved are $\hbar/mc$ and $\hbar/mc^2$ Therefore

$$\sigma < \frac{\hbar^3}{m^3c^4t}$$

For an energy of $2\ 3 \times 10^6$ volts *t* is 3 minutes and therefore $\sigma < 10^{-44}\ \text{cm}^2$ (corresponding to a penetrating power of 10^{16} km in solid matter) It is therefore absolutely impossible to observe processes of this kind with the neutrinos created in nuclear transformations

With increasing energy σ increases (in Fermi s model[3] for large energies as $(E/mc^2)^2$) but even if one assumes a very steep increase it seems highly improbable that even for cosmic ray energies σ becomes large enough to allow the process to be observed

If therefore the neutrino has no interaction with other particles besides the processes of creation and annihilation mentioned—and it is not necessary to assume interaction in order to explain the function of the neutrino in nuclear transformations—one can conclude that there is no practically possible way of observing the neutrino

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Feb 20

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[1] W Pauli quoted repeatedly since 1931 to be published shortly in Rapports du Septième Conseil Solvay, Brussels , 1933

[2] C D Ellis and N F Mott *Proc Roy Soc* A, 141 502 1933

[3] E Fermi *La Ricerca Scientifica* 2, No 12 1933

[4] This point of view was first put forward by I Curie and F Joliot at the Conseil Solvay 1933

[5] I Curie and F Joliot Nature 133 201 Feb 10 1934

Changes in the Lipolytic Activity of Different Organs during Tuberculosis

In continuation of our earlier work on lipases[1] we have followed the changes in the lipase content of different organs of guinea pigs infected with bovine tuberculosis Lipase determinations were made from liver pancreas lungs and blood serum using tributyrine as substrate It appeared that, coincident with the development of tuberculosis the lipolytic activity of liver pancreas and of blood serum is considerably lowered The results are given in the following table

Lipase Content (Titrated Lipase Units) per 1 gm of Fresh Material

	Liver	Pancreas	Lungs	Serum
Infected guinea pigs	396 (117–566)	425 (191 783)	85 (48–130)	28 (22–36)
Controls	1140 (898–1410)	832 (488–1391)	85 (46–107)	40 (34 46)

Each group consisted of five animals The infected animals were killed 2 10 days before the expected natural death The figures in brackets indicate the variations in respective series

In certain series when the bacterial strain used did not produce general tuberculosis the lipase contents of liver and pancreas were not lowered a decrease being noted only in blood serum

The cause of the decrease of lipolytic activity of different organs during tuberculosis is still problematic It might be assumed that the destructive action of the tubercle bacilli on the tissues also destroys the lipases This assumption is supported by our observation that in the sound portions of liver the lipase content is considerably higher than in the portions infected by tuberculosis

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Feb 14

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[1] *Acta Chemica Fennica* B 5 28 1932 *Z physiol Chem* 219 1 1933

The Third Vitamin D

A SHORT time ago[1] we reported that vitamin D found in ether extract of meadow hay had the same properties as described by Kon and Booth[2] for vitamin D in butter in that only one fifth of this vitamin after saponification is again found in the unsaponifiable fraction We have since examined butter and have been able to confirm Kon and Booth s results as regards its vitamin D content We considered it of interest to investigate whether the missing four fifths of the anti rachitic vitamin might possibly be found in the saponifiable fraction of the ether extract of butter or hay For this purpose a small excess of acetic acid was added and the free fatty acids taken up with ether and isolated It was then found that the missing four fifths of the original vitamin D were among the free fatty acids Thus with alkali it gives a water soluble substance deprived of alkali it is again soluble in ether

As certain difficulties were involved in giving daily doses of natural butter we tried to concentrate vitamin D in butter by shaking with a similar quantity of warm ethyl alcohol the melted butter fat which had been dried with sodium sulphate[3] [4] It proved that four per cent of the butter fat dissolved in the alcohol This four per cent had an anti rachitic strength 15 times as great as natural butter inasmuch as it was active in curative daily doses of 20 mgm as shown by Poulsson and Løvenskiold s method[5] The product which was obtained was twice saponified and yielded 11 09 per cent unsaponifiable matter Of this unsaponifiable matter it was necessary to give daily doses equivalent to 100 mgm of the original extract in order to obtain an anti rachitic result corresponding to 20 mgm of this Of the isolated free fatty acids 25 mgm per day produced the same effect as 20 mgm of the initial material Thus it will be seen that about a fifth of the anti rachitic vitamin has accompanied the unsaponifiable matter and about four fifths the saponifiable fraction We obtained a similar result with ether extract of meadow hay Here the daily doses of the hay powder extract were 4 mgm Of the unsaponifiable matter they corresponded to 20 mgm and of the fatty acids to 5 mgm

It was of interest to investigate whether the vitamin D from cow s liver behaved similarly Ether extract of cow s liver showed a suitable anti rachitic effect in daily doses of 40 mgm The unsaponifiable matter showed a corresponding effect in daily doses equivalent to 200 mgm and the free fatty acids had a similar effect in daily doses of 60 mgm In other words vitamin D in extract of hay cow s liver and butter has the same properties With ether extract of the human liver two thirds of the vitamin D is in the unsaponifiable matter and only one third among the free fatty acids These conditions vary somewhat in the human being in the individual cases a circumstance which is probably accounted for by the fact that the human being obtains sustenance from the products of both land and sea and thus has a stock of the various D vitamins

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March 6

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[1] NATURE 133 255 Feb 17 1934 In this letter an error appeared At the end of the second paragraph for 0 25 units read 10 units

[2] Kon, S K and Booth, R G *Biochem J* 27 1302 1933

[3] Shipley Kinney McCollum, *J Biol Chem*, 59 177 1927

[4] Zucker *Amer J Publ Health*, 23, 10, 1933

[5] Poulsson E and Løvenskiold H *Bioch J* 22 No 1 1928

Effect of a Meteoric Shower on the Ionosphere

OF the various agencies responsible for producing and maintaining ionisation of the ionosphere bombardment of the upper atmosphere by meteors has been suggested as one Skellett[1] has carried out a calculation of the energy received by the earth due to impact of the meteors and finds that during a meteoric shower it might be so high as a fourteenth of that due to ultra violet light from the sun He therefore concludes that meteoric showers might be one of the factors disturbing the ionisation of the upper atmosphere In order to find if any correlation exists between the occurrence of the two phenomena Schafer and Goodall[2] measured the height of the *E* region during the Leonid meteoric shower of 1931 They found that on some nights the ionic density attained high values Unfortunately their observations were vitiated by a magnetic storm which was in progress at that time Though they were unable to draw any definite conclusion regarding the correlation they summarise their observations by saying that there is reason to believe that the presence of meteors in unusual numbers can cause increased ionisation of an intermittent nature in the region of the lower layer

Considering the importance of the subject we thought it worth while to take records of the ionisation content of the *E* layer during the Leonid shower of 1933 The method employed was the well known one developed by Appleton[3] and consisted in determining the frequency at which upwardly directed radio waves pierced the region under investi gation Fig 1 depicts the results of our observations carried out on the nights of November 13, 14 and 17, 1933, between the hours 2300 and 0700 It will be noticed that on the nights of November 13 and 14 the equivalent electron densities attained values of $3\ 3 \times 10^6$ and $2\ 2 \times 10^6$ respectively The penetration frequencies for these ionic densities correspond to wave lengths of 87 and 71 4 metres

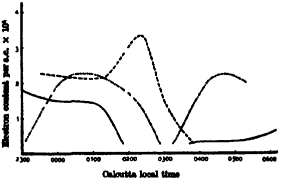

FIG 1 Electron content of the *E* layer during the 1933 Leonid shower
---- Nov 13 - - Nov 14 —— Nov 17

Such high densities are remarkable, because in the course of our fortnightly observations during the Polar Year 1932–33, we never recorded such densities In fact we were never able to obtain echoes on 75 metres for our midnight observations The high ionic density recorded, therefore, strongly suggests that the effect was due to the impact of meteors on the upper atmosphere It should be mentioned that records kept at the Magnetic Observatory, Colaba Bombay, and the Solar Observatory, Kodaikanal, Madras, show that no marked magnetic disturbance or solar activities occurred on these days

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[1] A M Skellett, *Proc Inst Radio Eng* 20 1933 1932

[2] J P Schafer and W M Goodall *Proc Inst Radio Eng* 20 1941 1932

[3] E V Appleton NATURE, 127 197 Feb 7 1931

Terminal and Initial Parenchyma in Wood

MR K A CHOWDHURY's remarks upon the position of the parenchyma in *Terminalia tomentosa*[1] would seem to be applicable to other woods also A recent examination of the wood of *Cedrela odorata* in this laboratory showed that the larger vessels of the early wood are partly embedded in parenchyma, some of which, judged by its position, was laid down rather earlier than these vessels It is possible that the latest wood of a season's growth consists chiefly of parenchyma, and that the early wood of the following season is similarly constituted, but the parenchyma is sufficiently homogeneous to render this possibility improbable Another specimen of *Cedrela*, probably *C odorata*, showed that the parenchyma separated a region of rather small, fairly thick walled fibres from another of larger, relatively thin-walled fibres, the comparatively large size and thin walls of the cells of the parenchyma in both these specimens suggest that it was laid down at the beginning of a season's growth, not at the end; it is desirable to confirm this by studies on the living tree

Several other Meliaceous woods were examined, but with less conclusive results In *Swietenia Mahagoni*, the parenchyma appears to be terminal and not initial, and in this wood the parenchyma cells are rather small, with relatively thick walls, which would seem to confirm the view that they are laid down at the end of the growing season In *Khaya grandis* and *Carapa guianensis*, it was not possible to decide if the parenchyma was terminal or initial

It is well known that the vessels of the pore ring in teak (*Tectona grandis*) may be associated with parenchyma, and it would seem to be justifiable to refer to this as initial parenchyma

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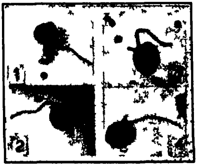
Feb 18

[1] NATURE 133 215 Feb 10 1934

Zoospore Ciliation in the Plasmodiophorales

ZOOSPORES of *Plasmodiophora brassicae*, Woron and *Spongospora subterranea* (Wallroth) Lagerheim have been described in the literature as uniciliate Examination of active zoospores would appear to substantiate this description However, when preparations stained by Cotner's[1] method are used, it can be shown that in addition to the long cilium, so apparent in the living zoospore, there is another which is shorter and less conspicuous This biciliate character is illustrated by photomicrographs of zoo spores of *P brassicae* (Figs 1 and 2) and *S subterranea* (Figs 3 and 4)



Great numbers of such zoospores were obtained by germinating, in dilute inorganic nutrient solutions, resting spores which had previously been wet, frozen and dried several times In size and manner of swimming, these zoospores fit the descriptions given by other writers

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[1] *Bot. Gaz* 89 295, 1930

Research Items

Lower Palæolithic 'Cleavers', Northern Nigeria Mr Henry Balfour in *Man* for February comments on the occurrence of the so called cleaver of lower palæolithic facies in Nigeria The implement is of axe like type characterised mainly by having the cutting edge formed by the intersection of two large flake scars one on either side of the surface of the implement The junction of the two scars along the lower margin affords a very sharp cutting edge which however does not stand prolonged hard usage Until recent years this type has received scant recognition since it had been noted as an occasional occurrence only among Chelleo Acheulean implements and was considered to be somewhat rare In South Africa it must be accorded the status of a dominant type in view of its abundance and wide distribution south of the Zambezi Its further dispersal in Africa is a matter of importance and its occurrence in northern Nigeria where it had not previously been recorded is to be noted Well defined examples are included in a collection of implements of lower palæolithic facies which is housed in the Government Offices at Jos on the Bauchi Plateau These were discovered largely in the course of tin mining operations Two examples of which sketches were made by the author are figured Of these one is about 16 cm long by 8 7 cm in maximum width and consists of a massive flake The greater area of one surface is the untouched scar of detachment the other surface exhibits a large area of coarse flaking The second is larger and better worked possibly of diorite 17 5 cm long by nearly 11 cm wide It is considerably weathered and patinated The form is more symmetrical and the flaking less coarse than in the first specimen but the technique is similar in the two instances There can be no doubt that the cleavers of West and South Africa are closely related morphologically

Tuamotuan Religion The religious beliefs of the natives of Tuamotu archipelago which extends for more than 600 miles from north west to south east between the Society Islands and the Marquesas are studied by Mr J Frank Stimson in *Bulletins* 103 and 111 of the Bernice P Bishop Museum Honolulu Few natives are now acquainted with the pre Christian beliefs but the difficulties of study are further increased by the fact that there would appear to have been two forms of belief an esoteric belief the cult of a supreme god Kiho knowledge of which was confined to priests and nobles and an exoteric cult for the ordinary people in which the name of the supreme deity was concealed or disguised This esoteric knowledge in the form of chants or cosmogonic descriptive and genealogical material was handed down from generation to generation but owing to a confusion with the powers of evil in early missionary days it came to be looked upon as suspect and has now almost vanished The philosophic ideas of the chants of which a series is recorded in *Bulletin* 111 were of an extremely high order Study of the distribution of this cult of which traces are to be found in various parts of Polynesia suggests that it was introduced into the Pacific by an early wave of Polynesians termed for convenience palæ Polynesian, the ideas it embodied possibly being derived from an ancient civilisation in south eastern Asia These palæ Polynesians carried the cult to Tahiti and thence in successive migrations to the marginal confines of Polynesia A later Polynesian wave which may be designated neo Polynesian developed a religious system emphasising the creative rather than the tree type of cosmogenesis wherein Tangaroa was viewed as the supreme creator The exoteric version of the cult posited a group of secondary gods whose attributes were suited to the beliefs of the people and served them as objects of worship and as tutelary deities

Land Snakes of Hong Kong Twenty nine species of land snakes belonging to twenty genera have been recorded from Hong Kong Territories and a key to the genera and some species has been compiled by G A C Herklots (*Hong Kong Naturalist* 4 113 Dec 1933) Of the twenty nine species no fewer than six are venomous and two of these are described and portrayed in colour—the common krait (*Bungarus multicinctus*) and the banded krait (*B fasciatus*) The bite of the latter is fatal to fowls and dogs but apparently not to man On the other hand the virulence of the common krait is about twice that of the cobra and twenty eight times that of the banded krait an account is repeated of the deaths of three men successively bitten by the Indian race of common krait while a fourth recovered after being seriously ill

Invertebrates from the Vanderbilt Museum A fourth volume of the reports on the collections made by Mr William K Vanderbilt on a series of cruises conducted in his yachts *Eagle* and *Ara* has now been published adding Cœlenterata Echinodermata and Mollusca to those on fishes and Crustacea (*Bull Vanderbilt Marine Museum* vol 4 Scientific Results of Cruises of the Yachts *Eagle* and *Ara* 1921 1928 William K Vanderbilt Commanding Cœlenterata Echinodermata and Mollusca By Lee Boone Huntington Long Island N Y) Four faunal regions are involved in these expeditions the West Indian region, the Labrador New England region the tropical American Pacific and the Mediterranean The depths dredged varied from quite shallow water to 900 fathoms besides littoral collections Notes from colour sketches made by Mr Vanderbilt on the spot are added The specimens are chiefly known species but one new coral is described *Corallum vanderbilti* from Cuba dredged by the *Ara* below 100 fathoms One colony of *Stenogorgia casta* Verrill hitherto only known from the type locality taken by the *Blake* was found off the Alligator Reef Florida and is many times larger than the type There is a magnificent collection of echinoderms with many details of spines and pedicellariæ well figured but perhaps the most interesting find was a mother octopus *Octopus vulgaris* about 10 in across the umbrella guarding her young the brood numbering 522 seven of which had not fully escaped from the egg capsule This was taken from a loggerhead sponge Knight s Key Florida dredging at 2 fathoms A female octopus may lay up to 1 000 eggs in a brood all connected by a thin flexible rope fastened in some rock crevice The mother tends them, blowing water on them through her funnel, cleaning and aerating them This is probably the first capture of an entire brood An egg laden female *Argonauta argo* with about 500 eggs in the shell was dredged from 300 fathoms from off Cape Mala, Panama

Larval Decapods from Madras. Mr M Krishna Menon describes some very interesting larvæ in his paper "The Life Histories of Decapod Crustacea from Madras" (*Bull Madras Gov Mus* New Series Natural History Section, Vol 3 No 3 1933) There are many decapod larvæ in the Madras plankton in the period immediately following the monsoons, the end of November and the four following months Not only do we know little about the life histories of the decapods from this particular region, but we also know little of those from almost any region, and any detailed investigation of this kind is valuable The animals chosen are *Acetes erythraeus* in the family Sergestidæ a *Callianassa* and (probably) a *Upogebia* species unknown, and *Hippa asiatica* Unfortunately it was not possible to hatch the eggs in the laboratory, but it was found that late larvæ could often be kept until they metamorphosed and the genus or species ascertained A complete account of the development of *Acetes* is given for the first time, for the larvæ are very common in the Madras plankton eight larval stages being described Both the Callianassa and Upogebiid are interesting and present unusual features the first having an abbreviated development showing certain affinities with *Axius*, the second having some unique features among the Upogebiinæ The adult of this last larva has not been obtained

Tropical Pacific Foraminifera In his paper The Foraminifera of the Tropical Pacific Collections of the *Albatross*, 1899–1900" (Part 2, Lagenidæ to Alveolinellidæ, United States National Museum Bull 161, 1933) J A Cushman continues to describe and illustrate the Foraminifera of the tropical Pacific collected by the United States Bureau of Fisheries steamer *Albatross* together with certain other related material from shallow water of the same region From the study of the shallow water Foraminifera living in the various oceanic islands, it has become evident that many species are very localised in their distribution, and probably a careful survey of the different island groups will show that there are many of these isolated species or varieties that have not yet been recognised When these occur, they are often to be found in great numbers, as is frequently the case with such localised species in other groups The genus *Lagena* is the largest of those recorded, with no less than 29 species and several varieties The author states that there is scarcely any other group of Foraminifera in which so much is needed in the way of detailed studies in regard to structure and variation Many of the species seem to be very widely distributed while others have very definite ranges He includes *Entosolenia* with *Lagena* although fully realising the distinction between them, leaving the complete study of this important group for future workers The paper is illustrated with 19 excellent photographic plates

Australian *Casuarinas* A short article in the *Argus* of Melbourne, Australia, dated March 4, 1933, gives a very interesting description of several commercially useful species of the genus *Casuarina* ("Australian Oaks, their Economic Value" by J. W. Audas) Australian species of *Casuarina* or 'sheoaks' are evergreen and grow rapidly, have long life, are free from diseases and pests, have wood which is of high quality for cabinet making and is resistant to the effects of weather, and even the bark is of medicinal value The trees will grow on the poorest of soils, and the young sprouts provide food for cattle To this end they are often pollarded Loose sandy soils may be stabilised by growing species of *Casuarina* upon them The economic characteristics of *Casuarina suberosa* (black sheoak), *C stricta* (drooping sheoak), *C Luehmannii* (buloke) and *C glauca* (grey buloke) are given, and a plea for their extended cultivation is made

Genetics of Poppies A genetical investigation of the poppies has been made by Dr J Philp (*J Genetics*, 28, No 2) In *Papaver Rhœas* which shows some self sterility, the inheritance of eight factors for flower colour has been investigated For seven of these factors 91 of the 128 possible phenotypes have been recognised These factors are found to fall into three linkage groups There appear to be two factors for hair colour, one of which is linked with two of the factors for petal colour Doubleness is incompletely recessive to singleness and is probably controlled by several factors Latex colour is also apparently determined by two factors and is affected by the factor p for flower colour The phenomena of segregation and crossing over are the same for the male and female sides The species is very heterozygous, while *P commutatum*, which has a narrower distribution, is very homozygous, indicating that the natural selection of types has been more intense or that mutations have occurred less freely This may perhaps explain the general dominance or epistasy of its characters over those of *P rhœas* The two species are regarded as recently differentiated from a common origin and both have $2n - 14$ chromosomes

Crustal Blocks in the Kwanto District In an earlier memoir (see NATURE, 129, 321, 1932), Prof N Miyabe showed that, in the Boso peninsula, the earth's crust consists of many blocks that have been tilted in various directions He has now applied the same methods to the south west Kwanto district (*Bull Earthq Res Inst*, 11, 639 692, 1933), using the vertical displacements of nearly 500 secondary and tertiary triangulation points during the interval 1892–1925 In this way, he has drawn the boundaries of 73 blocks the horizontal dimensions of which are about 10 km, and has determined the magnitudes and directions of their tilts Some of them may consist of several secondary blocks, each 2–3 km across Both the tilting and the vertical displacement of the blocks are, as a rule, greater to the west, than to the east, of the River Sagami Near Ooiso, one block was elevated 127 6 cm, while closely adjoining blocks to the north west were lowered by 67 9 and 77 5 cm Several of the boundaries of the blocks agree fairly well with known tectonic lines For example, the Tanna fault, along which displacements occurred with the earthquake of November 26, 1930, coincides nearly with the eastern boundary of a block in the Idu peninsula

Population Map of England. A map showing the density of population of England and Wales at the census of 1931 has been published by the Ordnance Survey (1*s* 6*d*, flat and unmounted) This completes the map of Great Britain, of which the Scottish sheet was published last year The scale is 1 to 1,000,000 Density of population is shown by deepening tints of brown, olive green and black, which merge as satisfactorily as tints can be expected to do There are twelve tints ranging from occasional" population of 0–1 per square mile to very congested" of 76,800 or more per square mile There are inset maps of the County of London (scale 4 miles to an inch) and county boundaries Names on the main map are those of towns, certain physical features and in blue, rivers and lakes Index letters and numbers in the margin facilitate reference The sheet overlaps the previously published one from northern Yorkshire to the Firth of Forth A one sheet edition of the combined sheets is also published

Rainfall in Netherlands Indies Dr J Boerema has extended his statistical study of the rainfall of the Netherlands Indies (*Kon Mag Met Observ Batavia* No 26) This is the fourth volume dealing with this subject and consists entirely of rainfall maps for Celebes on a scale of one to three million The maps give a picture of the average annual rainfall and also the average rainfall for each individual month by means of isohyets, the zones of different intensities bounded by the various isohyets are brought into prominence by a scale of shading and the use of blue tint for the heavier falls The interval between successive isohyets has to be large as Celebes lies in the tropical rain belt (the equator passes through the northern part of the island) and it is only in October that the blue tint (rainfall more than 300 mm that is than about 12 in) does not appear anywhere on the map The interval on the annual map is 500 mm except for the wettest regions where it changes to 1 000 mm and on the monthly maps is 50 mm for the dry regions and 100 mm for the wet The presentation of the rainfall in this form, although very good for most purposes is not very suitable for a comparative study of the seasonal variation of rainfall in different parts of the island They show however that the seasonal variation is far from following a similar course throughout the island

Progressive Lightning Schonland and Collens (*Proc Roy Soc*, A, Feb) have photographed a number of South African lightning flashes using a camera invented by Boys in which two lenses are mounted at opposite ends of a diameter of a circle and rotated at high speed about the centre of the circle Successive parts of a discharge are thus drawn out along a circular track By comparing the pictures produced by the two lenses moving in opposite directions, the nature of a flash may be elucidated The measurements show that in many cases the first stroke of a flash consists of a bright dart moving from cloud to earth with a velocity of the order 8×10^8 cm per sec The bright dart is of the order 50 metres long, and probably consists of an avalanche of electrons The evidence is that the flashes which show leader strokes are such that the base of the cloud is the cathode of the discharge and that a dart of electrons can be propagated at the velocities observed The strokes which follow the leader spread from the ground upwards, with higher velocities of the order 10^{10} cm per sec These strokes resemble flames rather than darts and it is suggested that the ionisation is thermal in character In some cases these main strokes branched upwards, the branches developing after the main discharge had developed at the branching point (see also NATURE, 132 407, Sept 9 1933)

Photochemical Union of Hydrogen and Chlorine Bateman and Allmand (*J Chem Soc* 157, 1933) describe some experiments on the effect of light of varying wave length on the photochemical union of a mixture of pure hydrogen and chlorine, which did not exhibit any induction period when confined over water Insolation was effected by either a quartz mercury lamp or a tungsten filament lamp in conjunction with a large aperture quartz monochromator The results correct some previously reported (cf NATURE 131, 656 May 6 1933) It was found that the rate of photochemical union in monochromatic light of wave length 313 mμ was proportional to the intensity and that the quantum yield was independent of wave length between 400 and 490 mμ The quantum yield remained of the same order also from 400 mμ to 290 mμ but appeared to fall off by 10 20 per cent when passing from the visible to the ultra violet region It also fell off when passing from 490 mμ to longer wave lengths It had previously been shown that the reaction was definitely sensitive to light of 546 mμ (the green mercury line) and in the present experiments a definite reaction was found in the region 540 550 mμ With monochromatic mercury lamp radiation of 492 mμ anomalous results were found This wave length lies just beyond the convergence limit 478 5 mμ of the chlorine banded spectrum The relative quantum efficiencies were found to be low at first but progressively increased from values below 1 to a constant value of 8 Interposition of dark periods during the increasing range caused a fall on re illumination but had no effect when the value 8 had been attained No anomaly *in this region was found with the continuous light* source

Heavy Water The *Journal of the American Chemical Society* of February contains several communications on heavy water and heavy hydrogen Gilfillan examined the density of water obtained by distillation of sea water, both that taken from a depth and that from the surface In both cases an excess of density above the normal was found Different samples of sea water gave the same specific gravity whilst tap water purified in the same way gave a different value the specific gravity of the distillate from sea water being 1 0000023 at 0 when water from tap water is taken as unity Halford Anderson and Bates find that transfer of heavy hydrogen from water to acetone occurs on warming the two liquids together in presence of potassium carbonate Davis and Johnston find a separation of hydrogen isotopes when water is treated with sodium G N Lewis and Schutz describe the properties of acetic acid containing the heavy isotope of hydrogen This acid melted 3 3° below ordinary acetic acid and shows a higher vapour pressure, because of the higher association in the vapour phase The heavy isotope was in the carboxyl hydrogen and no interchange with the hydrogen in the methyl group occurs on treatment Lewis, Macdonald and Schutz have prepared hydrochloric acid with the heavy isotope and measured the vapour pressures of the liquid and solid forms The results give $\log_{10}p_1/p_2 - 15\ 4/T - 0\ 075$ for the liquids and $\log_{10}p_1/p_2 = -57\ 7/T + 0\ 387$ for the solids The ratio of the vapour pressures reaches a maximum of 1 05 at the triple point, below which they approach each other as the temperature is lowered The calculated heat of fusion is very low

Outlying Museums of the Empire*

THE great survey of the museums of the Empire conceived by Sir Henry Miers and S F Markham has now been completed by them with the assistance of Dr F A Bather, T Sheppard and others The final reports on the museums in scattered outliers of the British Empire bring to a close a series of surveys which has reviewed more than a thousand museums and art galleries For the accomplishment and success of these surveys as well as to the surveyors credit must be awarded to the Carnegie Corporation of New York which financed the inquiries and to the Museums Association which acted as general headquarters and under the name of which the reports have been published Along with the reports proper (bound in paper covers) there are issued (bound in cloth as if for much service) a directory of the museums in Australia and New Zealand and another of those in the scattered islands of the Empire compilations the merit of which makes it certain that from this starting point the progress of these museums will be measured

The condition of the isolated and island museums is the most unsatisfactory revealed by the Empire Survey The reason may be possibly historic possibly psychological but whatever the cause all observers agree that the islands of the British Empire present one of the most difficult problems in the realm of cultural services Yet from the reports it is clear and one s own knowledge of their publications confirms that in places excellent scientific work has been done as in the Raffles Museum at Singapore or the Sarawak Museum at Kuching But in most places valuable scientific material is disappearing with little attempt at collection and conservation simply because finances are inadequate Exhibited collections suffer from the same inadequacies of money and staff though the fact that in several of the places illiterate natives form (as in Colombo) an overwhelming proportion of the museum visitors, must tend to discourage the utmost effort at arrangement since neither English nor vernacular labels are understood Yet these natives get pleasure and interest from the exhibits themselves

Many of the remarks in the report on Australia and New Zealand apply to both countries and indeed to other Dominions Both have been severely hit by the depression and the staffs of their museums have not kept pace with their growth or have been actually reduced with the inevitable deterioration Over and over again it is insisted that the chief need of a museum is a competent and keen curator who deserves an adequate salary We read of one of the oldest and most important museums being run by a director and a taxidermist and of university trained botanists and entomologists receiving less than £3 a week Buildings are often inadequate and liable to destruction by fire In these circumstances the good work already accomplished generally by private or municipal effort (more marked in New Zealand than in Australia) is to be warmly commended

Writing for the Carnegie Corporation the authors naturally emphasise the exhibition and educational side of museum work and occasionally seem merely to tolerate the researches made known by the museums in many excellent publications No doubt they themselves actually realise that in a new country being changed by civilisation the first duty of a museum is conservation and that research must precede exposition Governing authorities however are slow to realise the help that museums might give to education to general culture and to the severely practical work of life

The advantages of co operation are insisted on and here the Museums Association can extend its good work Recently it has brought into being a strong Empire Committee on which representatives of the Home Government and of the Dominions meet those who have conducted the surveys in order to administer to best advantage the funds allotted by the Carnegie Corporation But loans exchanges, and the pooling of information are no less important The Dominions desire much from the Homeland but is it not ridiculous that type specimens of British Jurassic plants and shells should as the Directory tells us be in an Antipodean museum ?

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* Reports on the Museums of Ceylon British Malaya, the West Indies etc Pp 58 Directory of Museums in Ceylon British Malaya Hong Kong Sarawak, British North Borneo Fiji the West Indies, British Guiana Pp 67 (London Museums Association 1933 1934) Reports with Directory 5s A Report on the Museums and Art Galleries of Australia by S F Markham and Prof H C Richards to the Carnegie Corporation of New York and A Report on the Museums and Art Galleries of New Zealand by S F Markham and W R B Oliver to the Carnegie Corporation of New York Pp v+113+13 plates Directory of Museums and Art Galleries in Australia and New Zealand Compiled by S F Markham and Dr H C Richards Pp 115 (London Museums Association 1933 1934)

The Roll call of the Hydrogens (Hydranes)

By Prof Henry E Armstrong, F R S

1 THE task of naming the homologues of hydrogen is not to be undertaken lightly Nomenclature is of such importance that all considerations should be laid aside except those of reasoned expediency and sound philological practice The example set by Faraday just a century ago in framing names for use in describing and discussing electrochemical phenomena may well serve us to day His words have stood the test of time because of the extreme care with which they were chosen

2 The new gases (from water) are clearly all *Hydrogens* (Water stuffs) as each has its own water in water They are to be grouped under their *Atomic Number* 1 as homologous members of the first term in the periodic series of elements It would seem to be desirable to have an index name common to all members of the group *Deuterium* is in no way reminiscent of water and also has no particular group significance Second to what ? is the question that at once arises The name would be a fit one for the first member of the second group (*Atomic Number* 2) in the periodic series If we could agree so to use it succeeding groups might well have similarly significant group names—*Triterium* *Tetraterium* etc up to 92 in addition to the familiar names

3 Members of the first group are logically all to be regarded and represented as *Hydrogens* in the same way that members of the C_nH_{2n+2} series of saturated hydrocarbons are all included under the group name

Paraffins or Methanes (*Ethanes*) The individual names of these all have the same ending and are also significant of composition, as a series of numerical indices are prefixed to a single terminal The principle thus followed in naming homologous paraffins may well be followed in naming hydrogens One of the happiest suggestions ever made was Hofmann's, that the terminal *ane* should be applied to all paraffins In the chemist's mind *ane* is now always associated with an initial series Hofmann took the second great step in systematic nomenclature, the first being that taken by Lavoisier and his colleagues Methyl, ethyl and propyl being well established, good names, he preserved these and began numbering at the fourth term, tetrane

4 Applying the Hofmann principle to the hydrogens we have the names

Hydrogen, Deuthydrogen, Trithydrogen

Maybe it will be found that the series ends here and that further addition of a proton gives rise to a complex which swallows its own tail, producing helium Helium may not be like a whale but it is very like the closed complex benzene Earthly chemists may be forgiven if they go so far as to imagine that not a few elements may come to be regarded as polyhelides, just as a large proportion of hydrocarbons are polybenzenes It is permissible to be prophetic even at a christening party Lord Rutherford would seem to forecast the possibility of a *prohelium*, in the second group, of weight 3—an elemental trimethylene

5 Hydrogen, however, is not a name that is universally used At least an alias, of a more general character, may be desirable In all humility, I suggest the simple term *hydrane* The analogy with methane will be obvious —

	Alternative symbols		
Hydrane	H	H^{α}	H
Deuthydrane	HH	H^{β}	H^{2}
Trithydrane	HHH	H^{γ}	H^{3}

With reference to the special symbols here introduced, we represent paraffins by complex structural formulæ, by special symbols such as CH_3 CH_3, why not hydranes ? Recent observations (NATURE, Feb 17) seem to indicate peculiarities in behaviour which justify, if they do not demand, the use of peculiar symbols

6 Compounds might be named systematically as follows

Hydranol	(Hydrol)	H O H
Hydranone	(Hydrone)	
Deuthydranone	(deuthydrone)	HH O HH
Hemideuthydranone	(hydrone)	H O HH
Hydranamine	(hydramine)	NH_3
Deuthydranamine	(deuthydramine)	NH_2.HH
Di ,,	,,	NH HH_2
Tri ,,	,,	N.HH_3
Deuthydranomethane		CH_3 HH
Dideuthydranomethane		CH_2 HH_2
Tri ,,	,,	CH HH_3
Tetra ,,	,,	C HH_4

7 If proton be the name given to the elemental unit H, the corresponding deuthydrogen or deuthydrane unit would be properly named if it were termed the *deuthydranon* or *deuthydron* I would go a step further, however, and ask if it be not expedient to pay homage to Prout, whose prophetic contention that the elements are all of unitarian build has now been placed beyond doubt by Aston's refined measurements ? Proton might well be changed into *prouton* This would be of meaning to all who have knowledge of the history of our science

8 The *neutron* creates a difficulty, as do all things not understood We shall do well, perhaps, to await its better acquaintance before attempting to place it by name Subatomic chemistry seems to be entering upon a phase not unlike that to which we are accustomed in atomic, structural chemistry—as the evidence grows that distinct structural units, not protons alone, are concerned The use of prefixes denoting energy differences may well prove to be desirable *Cataprouton* might serve as an alias of neutron in this event *Balliston* is another possibility, as it is a mere missile

9 The argument applies equally to electrons, now that so called positrons are claiming attention Might not these be brought under the Faraday hat ? Are such terms possible as an , ano or anodoelectron and cath , catho or cathodoelectron ? At present, the *on* is a mere terminal, without special significance An alternative would be to speak simply of l and d electrons, according to the twist given to them in the magnetic field

10 One other task that we have long shirked may be considered here—the naming of elements in the alternative states of atom and molecule Lavoisier drew a clear distinction between *oxygen*, the stuff in oxygen compounds, on one hand , and *oxygen gas*, on the other We now symbolise the difference by writing O and O_2 Hydrogen and oxygen are the stuffs in water—why not use the names only with this significance and term the gases *Dishydrogen* and *Disoxygen ?* We have no hesitation in speaking of dimethyl and diphenyl Ozone then becomes tris oxygen Maybe the now conventional *ion* terminal makes such change unnecessary though this is only applicable to hydrogen in salts The long familiar term *radicle* also still holds the field Probably together these terms will suffice in any case too many *radical* changes are undesirable

Rubber-Growing Research in the U.S.S.R.

A DETERMINED attempt to make Russia independent of imported rubber in a few years' time is being made by investigating the possibility of home grown rubber, and by the manufacture of 'synthetic rubber' , four factories are already engaged in the industrial production of the latter Research on the growing of rubber is carried out at two rubber institutes working in conjunction with the Institute of Plant Industry. Expeditions have been sent out to search at home and abroad for suitable rubber bearing plants, the indigenous flora having been particularly carefully surveyed

The three most promising plants so far appear to be *Parthenium argentatum*, Gray, *Scorzonera tau-saghys*, and *Taraxacum gymnanthum*, D C The first-named, the guayule, brought from Mexico, has been the subject of several investigations[1] This plant has several varieties, differing in rubber content, resistance to drought and cold, and also in the quantity and germination of seed produced, easy propagation by seed is important for the economical production of rubber from this type of plant

Scorzonera tau saghis grows wild in Central Asia, and was first described by the staff of the Institute in 1931 It is a slow growing perennial, very readily reproducing itself vegetatively, and is rich in best quality rubber *Taraxacum*, a biennial, occurs in the south of the Crimea Loman, Kotov and Tcherkasov have described the last two[2] These indigenous plants have not been under observation so long as the guayule, but are considered very promising owing to the high quality of their rubber and the ease of separating it The two native plants are also noteworthy for a low proportion of resin to rubber, and the fact that the rubber contained in them is in the form of fine threads, this form of occurrence has not been encountered previously by the investigators

Experimental plantations of the first two plants named above are in existence, many of them large enough to enable the trials to be carried out on a commercial scale It has been planned to have more than 500,000 hectares under rubber cultivation by 1937

[1] Nickolaev Astrov and others *Bull App Bot* 22 4 1929 2 3 1932 etc

[2] *Nature* [translation of the Russian title] 2 1933

University and Educational Intelligence

CAMBRIDGE —The governing body of King's College, having made provision for four additional fellowships open for competition to graduate members and research students of the University, offers for competition a fellowship in mathematics including theoretical physics to be associated with the names of the late Arthur Berry and Frank Ramsey Further information can be obtained from the Provost, to whom applications should be made by November 1

LONDON The title of reader in aeronautics in the University has been conferred on Dr N A V Piercy, East London College

Prof Karl Pearson has been appointed Heath Clark lecturer for the year 1934

WALES —The Council of University College, Aberystwyth, has accepted with regret the resignation of Principal Sir Henry Stuart Jones on the grounds of ill health Prof Gwilym Owen, professor of physics, has been appointed acting principal of the College for the remainder of the current session

A memorial tablet to the late Principal J H Davies has been unveiled in the College quadrangle

RESEARCH in chemistry and physics will be heavily subsidised by the United States Federal Government if a bill lately introduced into the House of Representatives for the establishment of research fellowships should be passed into law According to a Science Service report of January 19, the bill proposes that the Secretary of Commerce be given twenty million dollars for this purpose Any citizen with a bachelor's degree who demonstrates, by examination, his suitability, would be put to work under a university professor It is open to question whether the scheme is as sound as the Wisconsin plan (NATURE, 132, 977, Dec 23, 1933), for relieving professors temporarily of all teaching duties in order to enable them to devote themselves to research

Science News a Century Ago

Royal Society

On April 10, 1834, Mr J W Lubbock, treasurer, in the chair, nineteen further candidates were elected into the fellowship, contrasting with to-day's limit of seventeen allowed in a whole year Their names were —Viscount Adair, Charles Ansell, Felix Booth, Lieut Alexander Burnes, Francis Corbaux, Sir William Folkes, James W Freshfield, John Davies Gilbert, Edward Griffith, Edmund Halswell, Dr William Henry, Robert Hudson, the Rev William F Lloyd, John Phillips, Capt Walter N Smee, William Spence, Henry S Thornton, Dr John Warburton, Horace H Wilson

Among the newly elected in the above list, some names suggest special reference Felix Booth was a munificent patron of arctic and antarctic exploration Lieut (afterwards Sir) Alexander Burnes was a distinguished Indian officer who explored the Punjab, Afghanistan, and Bokhara, in 1830 33 Returning to England in 1833 he received a great welcome In 1841 Burnes met with a tragic fate, being killed by Afghan insurgents John Phillips, geologist, was a nephew of William Smith, the father of English geology In 1853 Phillips succeeded Strickland as deputy reader in geology at Oxford, three years later on the death of Buckland he was appointed to the professorship William Spence, entomologist, collaborated in many publications with William Kirby elected into the Society sixteen years earlier

Death of John Fuller

On April 11, 1834, John Fuller of Rose Hill, Sussex, who founded the Fullerian professorships at the Royal Institution, died in Devonshire Place at the age of seventy seven years In 1777 he had succeeded to the estate of his uncle Rose Fuller M P for Rye, and three years later was elected M P for Southampton, holding his seat until 1784 Made Sheriff for Sussex in 1797, in 1802 he was elected M P for the county after a contest lasting sixteen days and costing him £20,000 in addition to a purse of £30,000 subscribed by the county He sat until 1812 On one occasion in 1810 Fuller made a scene in the House, was taken into custody and severely reprimanded by the Speaker At Rose Hill he erected an observatory He was buried on April 18, 1834, in the family vault at Brightling, Sussex

James Bowman Lindsay

On April 11, 1834, the *Dundee Advertiser* published the following advertisement J B Lindsay resumes classes for cultivating the intellectual and historical portions of knowledge and instruction on April 14, 1834, in South Tay Street, Dundee In a few weeks hence a course of lectures will be formed on frictional, galvanic, and voltaic electricity, magnetism, and electromagnetism The battery, already powerful, is undergoing daily augmentation The light obtained from it is intensely bright, and the number of lights may be increased without limit A great number of wheels may be turned by electricity, and small weights raised over pulleys Houses and towns will in a short time be lighted by electricity instead of gas, and heated by it instead of coal, and machinery will be worked by it instead of steam—all at a trifling expense A miniature view of all these effects will be exhibited, besides a number of subordinate experiments, including the discoveries of Sir Humphry Davy " Lindsay was born in 1799 and died in 1862

Self-Instruction in Chemistry

The popularity of chemistry a century ago is recalled by an article entitled Practical Helps to a Cheap Course of Self Instruction in Experimental Chemistry ', contained in the *Mechanics Magazine* for April 12 1834 The extensive utility of chemical knowledge the writer said has caused it to be very generally nay almost universally cultivated but it is a branch of philosophy so entirely founded on experiment that no person can understand it so as to verify its fundamental truths unless he conducts experiments himself A notion that a laboratory fitted up with furnaces and expensive and complicated apparatus is absolutely necessary to perform chemical experiments is exceedingly erroneous , in fact diametrically opposite to the truth For all ordinary chemical purposes and even for the prosecution of new and important inquiries very simple means are sufficient The writer gave a list of pieces of apparatus and of the substances which should be obtained the whole of which were considered to be in the reach of persons of even the most modest means and intending experimenters were advised to purchase their chemicals from either Mr Dymond 146 Holborn bars or Mr Davy 390 Strand

FitzRoy on the River Santa Cruz

On April 13, H M S *Beagle* anchored in the mouth of the Santa Cruz where she remained until May 12 On April 18 Capt FitzRoy set out with three whale boats to explore the river and was away until May 8 Darwin accompanied the expedition and his Diary contains an account of the work done The party consisted of twenty five souls all well armed and capable of defying a host of Indians With a strong flood tide & a fine day says Darwin we made a good run, soon drank some of the fresh water & at night were nearly above the tidal influence The river here assumed a size & appearance which even at the highest point we ultimately reached was scarcely diminished It is generally from three to four hundred yards broad & in the centre about seventeen feet deep , and perhaps its most remarkable feature is the constant rapidity of the current, which in its whole course runs at the rate of from four to six knots an hour In so strong a current it was of course quite impossible either to pull or sail, so that the three boats were fastened astern of each other , two hands left in each & the rest all on shore to track (we brought with us collars all ready fitted to a whale line) The tracking party was divided into two and *every one* pulled in alternate spells of one and a half hours '

On April 22, Darwin records The country remains the same, and terribly uninteresting The great similarity in production is a striking feature in all Patagonia " On April 29, he says, from the high land we hailed with joy the snowy summits of the Cordilleras, as they were seen occasionally peeping through their dusky envelope of clouds' On May 4, the party was about 140 miles from the Atlantic and 60 miles from the nearest inlet of the Pacific, and here they ' took a farewell look at the Cordilleras which probably in this part had never been viewed by other European eyes, & then returned to the tents" By May 8, they were back at the mouth of the river where they found ' the Beagle with her masts up, freshly painted, & as gay as a frigate"

Societies and Academies

LONDON

Mineralogical Society, January 25 JAMES PHEMISTER Zoning in plagioclase feldspar The paper describes various types of zoning in plagioclase feldspar in the calciferous sandstone basalt lavas in one district of Scotland The zoning is classified as (*a*) normal (*b*) simple reverse (*c*) oscillatory Simple reverse zoning is associated with other differences in the zones which point to important time intervals between the growth of the zones Oscillatory zoning classified as oscillatory normal and oscillatory reverse and attention is directed to the occurrence of oscillatory zoned crystals which show no general *tendency towards either more calcic or more sodic* plagioclase Distinction is drawn between the main zones and the thin shells of alternately more and less calcic composition within the main zones The alternating composition of the thin shells is possibly the result of lack of balance between rate of growth of the crystal and rate of diffusion from the surrounding magma Recurrence of calcic plagioclase in the inner part of main zones is explained as the result of eruption of hot magma into the crystallising liquid probably consequent on eruption of lava at higher levels H H READ On zoned associations of antigorite talc actinolite chlorite and biotite in Unst Shetland Islands In an injection zone within the staurolite kyanite garnet gneisses of western Unst occur spherical or ellipsoidal bodies up to 20 ft in diameter composed of an interior of antigorite followed outwards by an orderly sequence of zones made up entirely of talc of actinolite of chlorite and of biotite It is considered that the zoned bodies result from the fragmentation of peridotite sills during the staurolite kyanite garnet metamorphism, followed by the entry of fluids into the masses during injection metamorphism and the formation of the zonally arranged layers At the same time, material displaced from the masses reacted with the country rock to give the biotite zone Transitions to the country rock were mostly pared away during the later chloritoid and chlorite producing metamorphisms that have affected the staurolite kyanite garnet gneisses M H HEY and F A BANNISTER Studies on the zeolites (7) Clinoptilolite, a silica rich variety of heulandite Rotation photographs of a single crystal from the original specimen of clinoptilolite (so called 'crystallized mordenite of L V Pirsson) show that it is a silica rich variety of heulandite The chemical composition and optical properties are in agreement with this interpretation The mineral bears no relation to ptilolite B RAMO RAO and A BRAMMALL Notes on cordierite in the Dartmoor granite Two groups of associated, but as yet unrelated, facts were recorded concerning the sector twinned cordierite in the garnetiferous granite of Sweltor (1) an aggregate of cordierite grains is separable into fractions varying in composition , in particular, the molecular ratio FeO/MgO varies from 0 37 to 1 28 in six intermediate fractions analysed, the ratio for the aggregate being 1 52 (2) all sectors are optically negative, but the value of $2V$ varies between 56° and 72° Centrally paired sectors give the same $2V$ value, whereas adjacent sectors often give different values, the maximum difference observed being 12°

Physical Society, February 2 S R Rao and G Sivaramakrishnan A new method of determining the magnetic susceptibilities of gases and vapours Compensation is effected for the test bulbs , and the influence of surface condensation, if any, of gases and vapours can be allowed for Electromagnetic re torsion is employed and the arrangement is rendered independent of small changes in the magnetising current The molar susceptibility of carbon dioxide was found to be $-(20 79\pm0 08)\times10^{-6}$ L R Wilberforce Magnetised ellipsoids and shells in a permeable medium The probability that the field round a thin normally magnetised shell is independent of the permeability of the medium surrounding it is discussed W D Wright and F H G Pitt Hue discrimination in normal colour vision Hue discrimination curves have been obtained for five normal observers the apparatus and method of observation are described and the results discussed Two minima in the discrimination curve are found at about 0 60μ and 0 49μ and a secondary minimum at 0 45μ The curves are appreciably different from those normally reproduced in textbooks particularly at the red end of the spectrum where a secondary minimum has generally been shown N R Tawde Intensity distribution in molecular spectra N_2 second positive system Intensities of bands in the $c^3\pi\rightarrow b^3\pi$ system of N_2 under four different conditions of excitation have been measured by means of calibrated photographs of the spectrum transition probabilities derived from these have been compared with the Condon parabola as obtained from Morse s and Rydberg s potential energy functions effective temperatures have been derived on the assumption of a Boltzmann distribution for vibrational energy

Dublin

Royal Irish Academy, January 22 Joseph Algar and John P Flynn A new method for the synthesis of flavonols Flavonols may be prepared in small yield, by the oxidation of flavindogenides of the type 3 benzylidene flavanone in alcoholic alkaline solution by means of hydrogen peroxide Considerably better results are obtained by adding 30 per cent hydrogen peroxide to a solution of an *o* hydroxyphenylstyryl ketone in hot alcoholic potash The preparation in this manner, of a number of flavonols is described Since *o* hydroxyphenyl styryl ketones are readily prepared the reaction affords a convenient method for the synthesis of flavonols The products are readily purified and in most cases satisfactory yields (20–40 per cent) are obtained

Edinburgh

Royal Society, March 5 E B Bailey and W J McCallien The metamorphic rocks of north east Antrim The schists of Antrim fall into the following Scottish groups Ben Lui Schists, Loch Tay Limestone, Pitlochry Schists, Green Beds, Ben Ledi Schists The Loch Tay Limestone outcrops at Torr Head and passes north westward under the Ben Lui Schists The local evidence does not definitely decide whether this is due to inversion or not The main interest is the occurrence of green beds on two distinct structural levels, the lower at Leckpatrick and Loughaveema, the upper at Runabay Head and Cushendun Bay This is probably caused by recumbent folding of a single horizon Support is thus lent to Clough's interpretation of Cowal Other features of the district are the prominence of albite schists in the Pitlochry and Ben Ledi groups and the frequent development of hornblende in the green beds This last is largely attributed to alteration by the Cushendun granite Robert Carrick Spermatogenesis of axolotl (*Amblystoma tigrinum*) The haploid chromosome number in the male is fourteen plus a small accessory chromosome which usually divides in the first maturation division This division is the meiotic one and is preceded by parasyndetic union of homologous chromosomes Pairing is initiated at the proximal pole of the nucleus and the polarised homologues twist about each other from the very onset of syndesis equivalent chromomeres along their length being brought together during the process Amitotic division does not occur among primary spermatogonia Details of spermogenesis are not discussed P Ch Koller Spermatogenesis in *Drosophila pseudo obscura* Frol (2) The cytological basis of sterility in the hybrid males of races *A* and *B* The chromosome behaviour of the sterile hybrid male during spermatogenesis is highly abnormal The chromosomes remain univalent usually in the first meiotic division aneuploid and sometimes polyploid spermatids are formed which degenerate The chromosomes of races *A* and *B* are at least partially homologous and they are associated in the hybrid female Therefore it is suggested that the cause of anomalous chromosome behaviour is genetical Complimentary genetic factors are responsible for the sterility of hybrid males Thomas Nicol Studies on the reproductive system in the guinea pig observations on the ovaries with special reference to the corpus luteum Data for forty female guinea pigs are analysed If several corpora lutea are formed at the immediate post partum ovulation and the animal becomes pregnant all of these persist and become corpora lutea of pregnancy whether or not all the ova were fertilised Numbers of new and old corpora lutea seldom correspond in the same female Prenatal mortality is 29 5 per cent and seems chiefly due to lack of fertilisation of the ova shed No evidence for alternating action of ovaries or that migration of ova occurs In subsequent pregnancies the uterine horn used is a matter of chance

Leeds

Philosophical and Literary Society, December 12 C W Gilham The condition that a certain integral may be rational The invariant condition that the integral $\int fdx/\varphi^2$ should be rational in value is obtained f and φ being polynomials of degrees seven and three respectively R Whiddington and F C Poultney Note on the photographic intensity measurement of moving electron beams A very brief account of a method of comparing electron beam currents of widely different values by moving the beams across a photographic plate at known rates and comparing the resulting densities of the traces R Whiddington Note on a new transition produced by electron impact in helium This note refers to a letter in Nature of June 24, 1933, where it was pointed out *inter alia* that electrons of a few hundred volts energy produced, in addition to the well known $(1^1S_0 - 2^1P_1)$ transition of 21 1 volts, another line at about 42 volts corresponding to two successive collisions by the same electron and yet a third line at about 60 volts Careful measurement of this last line shows it to correspond to a loss of 59 2 volts It cannot therefore be due to the process $3(1^1S_0 \rightarrow 2^1P_1) = 63 3$ volts—a result not unexpected in view of the high probability of the transition as shown by the density of the line in the photographs It is likely to be due to some multiple excitation in which the same impacting electron within the atom carries out more than one process—such for example as simultaneous excitation of the two atom electrons or even possibly ionisation plus excitation H M DAWSON and N B DYSON The rate of hydrolysis of bromoacetic acid in relation to its degree of ionisation The marked fall in the rate of hydrolysis of bromoacetic acid which is observed when the hydrogen ion concentration is increased by the addition of a strong acid cannot be attributed to the elimination of the reaction which depends on collisions between bromoacetate ions and water molecules On the contrary the fall is mainly due to the reduction in the velocity of the hydrolytic process which is primarily due to collisions between bromoacetate ions and bromoacetic acid molecules J W BELTON The kinetic interpretation of the activity coefficients of non electrolytes The activity coefficient of a non electrolyte in presence of an electrolyte is dependent on the adsorption potential at the solid liquid interface The expression derived is in qualitative agreement with experiment C H DOUGLAS CLARK Spectroscopy and valency (2) The periodic groups of non hydride diatomic molecules The classification of non hydride diatomic molecules into their appropriate periodic groups becomes possible according to various combinations of (1) two groups of non bonding electrons (nine kinds) and (2) one group of shared electrons (twenty kinds) The groups resemble those of the Periodic Table and are divided in a similar way into *A* and *B* sub groups The new table possesses the leading advantages of the older classification Further discussion is to follow C H DOUGLAS CLARK An interconversion scale for energetic and related magnitudes in the electromagnetic wave band Interconversion of the magnitudes wave length wave number frequency electron velocity mass temperature corresponding to maximum energy energy in electron volts ergs calories and kilogram calories per gram molecule may be conveniently accomplished by means of a scale covering the electromagnetic wave band over 90 octaves from λ 10^{20} to ($\approx$) 10^{-7} A Advantages of the scale in spectroscopic and general work are noted with special reference to losses of mass occurring on assembling *atomic nuclei from their constituent* parts and to the temperature corresponding to energy of maximum density L LOOSE W H PEARSALL and F M WILLIS Carbon assimilation by *Chlorella* in Windermere Measurements of oxygen production by *Chlorella vulgaris* at different depths in Windermere show that carbon assimilation exceeds respiration on an average August day to a depth of ten metres which also represents the depth of the epilimnion at that time Cell division was apparently most rapid below this depth but cell extension and cell mortality are highest nearest to the surface

PARIS

Academy of Sciences, February 12 (*C R* 198 625 684) V GRIGNARD The preparation of certain organomagnesium compounds by removal In cases where the yield of the organomagnesium compound is small or nothing the addition of a solvent such as ethyl bromide which appears to keep the surface of the magnesium clean has been found to give good results The method has been successfully applied to *p* bromveratrol *p* dibrombenzene and similar difficult reactions LOUIS ROY The conditions of visibility and the separation of a satellite star J TOUCHARD A problem of permutations ALFRED ROSENBLATT *Non linear m harmonic equations* with two independent variables ANTOINE MAGNAN and CLAUDE MAGNAN A chronophotograph with ultra rapid recording The apparatus described and illustrated is designed to give 30 000 images per second MICHEL LUNTZ and PAUL SCHWARZ Circular alternated eddies GEORGES BRUEL Map of the Moyen Ogooué to the sea (1/500 000) of A Meunier (1932) AL PROCA Particles that may be associated with the propagation of a light wave LÉON and EUGÈNE BLOCH A new spectrum of zinc Zn IV JEAN SAVERNIN Polarisation by remote diffraction at the rectilinear edge of a steel screen JEAN BOUCHARD Influence of the solvent on the law of variation of the fluorescent power of certain colouring materials as a function of the concentration of their solutions AUGUSTIN BOUTARIC and MARIUS PEYRAUD The relation between the ascent of colloidal granules in porous bodies and their adsorption in the support in which the rise takes place O BINDER Action of aqueous solutions of copper sulphate on cupric hydroxide Both the method of Schreinemakers and X ray analysis lead to the conclusion that the definite compound $4CuO\,SO_3\,4H_2O$ is the only substance produced by the interaction of aqueous solutions of copper sulphate and cupric hydroxide DANIEL MOTARD The alkaline bismutho iodides A VILA The rapid microdetermination of phosphorus in organic products The ammonium phospho molybdate precipitate is measured in a special form of tube after centrifugation CH PRÉVOST and I OSSON The knowledge of the stycerols MARIUS BADOCHE The preparation of 1 1 3 triphenyl 3 carboxy rubene $C_{33}H_{22}CO_2H$ and its alkaline salts MARCEL GODCHOT and MLLE GERMAINE CAUQUIL The active *cis* and *trans* 1 methyl 3 cyclohexanols HENRI CLÉMENT The organo magnesium compound of pentamethylbenzene This compound cannot be obtained by the usual method but on adding some ethyl bromide as suggested by Grignard the reaction takes place normally with good yields S GOLDSZTAUB The crystalline structure of iron oxychloride Results of a complete X ray study JACQUES DE LAPPARENT The constitution and origin of leverrierite C ARAMBOURG The eruptive formations of Turkana (Eastern Africa) MME E JÉRÉMINE The volcanic rocks on the western edge of Lake Rodolphe TONY BALLU The condition of the soil and the effect of an agricultural tractor CHARLES ROUSSEAU The structure of the hepatic epithelium of the eolidians MLLE ANNE RAFFY The influence of variations of salinity on the respiratory intensity of *Telphusa* and crayfish C LEVADITI A VAISMAN and MLLE R SCHOEN The biological properties of the syphilitic virus contained in the residual syphilomes of treated animals FERON and ANDRÉ LANCIEN The association of the cinnamic radical and copper in the treatment of leprosy After prolonged study (four thousand injections) the author concludes that the cupro cinnamic complex probably attacks the root of the disease It is painless and can be injected even in very young subjects If it does not always cure there is scarcely a case in which it cannot bring about marked improvement

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Sunday, April 8

BRITISH MUSEUM (NATURAL HISTORY) at 3 and 4 30 Capt Guy Dollman The Evolution of the Horse *

Monday April 9

VICTORIA INSTITUTE at 4 30 Mrs A S D Maunder Early Hindu Astronomy

ROYAL GEOGRAPHICAL SOCIETY at 5 —Capt M Hotine The East African Arc of Meridian

Friday April 13

ROYAL SOCIETY OF ARTS at 4 30 J H Field Indian Meteorology

INTERNATIONAL RADIO CONGRESS April 10–15 —To be held at Warsaw

FARADAY SOCIETY April 12 14 —General discussion on The Determination and Interpretation of Dipole Moments to be held at Exeter College Oxford

GEOGRAPHICAL ASSOCIATION April 13 14 —Spring Conference to be held at Glasgow

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Official Publications Received

GREAT BRITAIN AND IRELAND

Ministry of Agriculture and Fisheries Collected Leaflets No 2 Insect Pests of Fruit Trees Pp iv+104 (London H M Stationery Office) 1s 6d net

Memoirs of the Cotton Research Station Trinidad Series B Physiology No 5 Further Studies on Transport in the Cotton Plant 1 Preliminary Observations on the Transport of Phosphorus Potassium and Calcium 2 An Ontogenetic Study of Concentrations and Vertical Gradients By T G Mason and E J Maskell Pp 125 178+119–141 (London Empire Cotton Growing Corporation) 2s 6d

Reports of the Progress of Applied Chemistry Vol 18 1933 Pp [illegible] (London Society of Chemical Industry) 12s 6d to Members 7s 6d

Subject Index to the Geological Literature added to the Geological Society's Library during the Years ended December 31st 1923 and 1924 Pp 144 (London Geological Society) 5s

The Generic Names of British Insects Prepared by the Committee on Generic Nomenclature of the Royal Entomological Society of London, with the Assistance of the Department of Entomology of the British Museum (Natural History) Part 2 The Generic Names of the British Rhopalocera with a Check List of the Species Pp ii+9–40 (London Royal Entomological Society) 3s 6d

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Agricultural Marketing Boards in Great Britain

THE marketing of agricultural produce is much more difficult than that of factory produce The time element dominates production in spite of all advances in science, a cow still takes nine months to produce a calf and a ewe takes five months to produce lambs by no known method can these processes be hastened and still more months have to elapse before either calf or lamb is of much value as food Seed time and harvest come much as they did a thousand years ago wheat is still in the ground some eight or nine months before it is ready for cutting However, while plants and animals move slowly prices change rapidly, and it has happened frequently in recent years that farmers have started the production of lamb milk or bacon on perfectly sound methods fully in accordance with the prevailing level of prices but long before the commodity was ready for sale prices had changed so drastically as to involve the farmers in heavy financial loss Obviously science could do nothing to help the trouble was purely economic

Further until recently farmers produced only one or two commodities on contracts in the main they produced simply in hope of a favourable market Only because they happened to be thrifty people trusted by merchants and bank managers has it been possible for them to keep going during the past few years

Until a few months ago the agricultural situation had been rapidly getting worse and even the most stable farmers in Great Britain found themselves in financial difficulties An agricultural crisis at the present juncture had obviously to be avoided, and the Minister of Agriculture went straight to the heart of the matter and took economic measures to deal with an economic problem Improvements in marketing were worked out

Two types of methods have been adopted For wheat, the farmers of Great Britain are guaranteed a definite share of the home market at a definite price level The share is called the 'quota', and the difference between the agreed price and the ultimate market price is borne on the general wheat account of the country and not by the Exchequer Actually there has been no appreciable rise in price of bread, but the quota, while sufficient for agriculture, is only a small part of our total consumption, so that disparities in price between English and imported wheat would scarcely be likely to have much effect on the price of the final loaf

For meat, milk and potatoes, other methods were adopted We already produce something like half our total meat supply, the whole of our liquid milk, and almost the whole of our potatoes Any increase in price paid to the farmer would therefore be felt sharply by the consumer, to whom the distributor would certainly pass it on The method adopted has been to set up Marketing Boards' to assure that the produce of the British farmer, at any rate up to a specified total, should find a market The details of working do not concern us here they have necessarily to vary with the commodity There is a general disposition among farmers to accept the schemes, with all the restrictions they imply The farmer is now finding that under these new conditions he cannot produce what he likes and sell how he likes having accepted the protection of the new Boards he must conform to their regulations The result is virtually to put agricultural production on to a contract basis, just as most manufacturing production is done, but the farmer is in the somewhat more favourable position that he can, if necessary, produce much of his own raw materials

It is obviously essential to the success of the scheme that production should be as economical and efficient as possible, and that all wastes and losses should be reduced to a minimum Power has therefore been given to the Boards to undertake or foster scientific research wherever this is deemed necessary This provision need not, and should not, cut across existing provision made by the Ministry of Agriculture and financed out of the Development Fund There are at present some twelve research institutes, at Rothamsted, Cambridge, Oxford, Aberdeen, Reading, Long Ashton, East Malling, and elsewhere, concerned with research into the various aspects of agricultural science and practice soils, plant nutrition, plant pathology, plant genetics, animal nutrition, animal health, animal genetics, dairying, fruit and others These institutes exist for the purpose of gaining knowledge, which is then (in principle, at any rate) passed on to the county agricultural staffs to be sorted out by them, so that information of interest to the farmers of any particular region may be given to them Various methods are adopted by the different institutes for actually effecting the transmission of information, and it is admittedly a difficult business, but it is done

The powers now conferred upon the Marketing Boards will enable them to keep in touch with the research institutes and ensure the systematic collection and dissemination of existing knowledge, and the completion of work necessary for filling gaps The Potato Marketing Board, for example, will certainly find that a great deal remains to be discovered about the growth and storage of potatoes A conference was recently called at Rothamsted, dealing with these very problems and by a fortunate circumstance its chairman was also chairman of the Potato Marketing Board But the papers and the discussion revealed many important problems on which existing information is quite inadequate More will clearly have to be obtained, but the work must be focused on the problems of the potato grower on the production, the quality, the keeping powers, and the avoidance of diseases and pests of the potato crop

Two methods will probably need to be adopted by the Boards The appropriate existing institutes can be strengthened to deal with specific problems this is not likely to be costly and it will so far as it goes, be economical and effective But the second method is at least as important It is to set up a small experiment station devoted exclusively to the study of the crop concerned and place it in the midst of the chief growing region, so that growers can easily visit it and the staff can keep themselves fully posted in the growers problems and difficulties

Three such stations have already been in existence for some time, and their success testifies to the value of the method the Fruit Research Station at East Malling, the Fruit and Cider Research Station at Long Ashton, Somerset, and the Nursery and Market Garden Research Station at Cheshunt, which devotes itself mainly to tomatoes and cucumbers, the chief products of its district All these, especially the two former, are larger than would be needed by the Marketing Boards, but the general type would serve well The Cheshunt Station affords the best model its committee is appointed partly by the growers and partly by the Rothamsted Experimental Station Committee, its staff is in close touch with Rothamsted and with the Plant Physiology Department of the Imperial College of Science, but at the same time it is so close to the growers that it misses none of their difficulties It has achieved remarkable success A Potato Research Station situated in one of the chief potato growing districts, but so organised as to be in close touch with the appropriate research institutes, would under suitable management be expected to be similarly successful It is however important that the staff should be men of sound scientific training and outlook the good practical growers already know all that the so called practical man can teach them and the only one likely to be of help is the scientific worker experienced enough to show that he can use the tools of science for solving practical problems and young enough to be able to adapt himself to the conditions of an important industry and to throw himself whole heartedly into the new work

Sugar beet is another crop that deserves very serious scientific attention Happily a research scheme has now been set on foot in which the sugar beet factories are co operating with Rothamsted the National Institute of Agricultural Botany the Oxford Institute of Agricultural Engineering and the Norfolk Agricultural Station each of which undertakes a particular group of problems For the moment the scheme is only on a year to year basis and so it loses the efficiency that comes only with a longer time basis nevertheless the fact that it is working shows a sound spirit of appreciation of the value of scientific assistance for its growers on the part of those responsible for the factory organisation

The Endocrine Glands

The Tides of Life the Endocrine Glands in Bodily Adjustment By Dr R G Hoskins Pp 352+8 plates (London Kegan Paul and Co Ltd 1933) *15s net*

THIS little book has been written by the Director of Endocrine Research in the Medical School of Harvard University and we must congratulate the author on his performance He has produced an admirably written manual which will be of the greatest service to all desiring the latest information about the structure and functions of the endocrine glands What especially awakens our admiration is the note of scepticism and caution which colours his language when he is relating the latest extravagances of those endocrinologists who claim to be able to resolve character and personality into endocrine chemistry This same caution leads him to view with grave doubt the theory of Sir Arthur Keith that the structural differences between human races are due to differences in endocrine development He points out that according to this theory the Negro should exhibit defective sexuality since Keith attributes this melanism to a defective adrenal development but it is notorious that the very opposite is the case

Our chief complaint against the author is that he has a strong tendency to over estimate the part played by his countrymen in this field of research The diagnostic feature of an endocrine gland is that it produces a hormone and it is only on page 300 that we reach a brief account of the foundation research of Bayliss and Starling which initiated this whole province of biological investigation and it is mentioned quite casually— indeed the word hormone was first used in connection with this research Assuredly it was Bayliss and Starling invented the term and defined what they meant by it

It seems to us too that the author loses his usual caution in his enthusiasm for some very recent results obtained by American workers—as for example those of Cannan When we are told that an animal suffers no inconvenience when its entire chain of sympathetic ganglia is cut out most of us will become deeply thoughtful—and wait

The author raises some extremely interesting questions during his discussions and to two of these we propose to allude briefly The first of these concerns the constitution of the cells which make up the male and female bodies respectively On the sex chromosome theory the tissues of male and female should have different growth capacities since the nuclear constitution in all the cells of the male body is different from what it is in those of the female But as the author remarks this difference must be potential only for these tissues obstinately refuse to produce the appropriate secondary sexual differences unless they are flooded with the sexual hormones But he could have gone further and said that grafting experiments proved that the tissues of both males and females with judicial impartiality will produce the secondary sexual organs of *either* sex if exposed to the action of the appropriate hormone so that the difference in nuclear constitution seems to be without effect

Another question discussed by the author is the evolutionary origin of the endocrine organs How did a tiny group of cells constituting a minute fraction of the substance contained in the body acquire its tremendous powers ? On the chance theory of the origin of variations how did Nature chance to construct organs of such enormous potency ? Now in the case of two of the most important of these organs comparative embryology has supplied the answer and has shown that here, as in all properly analysed cases of evolution, development has been slow, functional and continuous.

The thyroid gland of *Amphioxus* begins as a growth, the so-called endostyle, in the mid-ventral line of the pharynx: this groove carries lines of ciliated cells and intervening lines of mucus-producing cells. By their joint aid a cord of mucus is produced which is worked forwards to the mouth, where it is broken up into a network of filaments by the inrushing current of water produced by the cilia lining the gill slits. The tiny organisms, plant and animal, borne in the water are entrapped and the net with its living prey carried back to the intestine and swallowed. The iodine necessary to all animals is thus secured, since the microscopic plants are a potent source of it. (It is curious to find the author describing the endostyle of *Amphioxus* as a "pouch of the gut producing a mucus which probably aids digestion". Such an answer given by an English medical student sitting for his first M.B. examination would get a very black mark from his examiner.) There is nothing mysterious about the thyroid or endostyle' of *Amphioxus*. Similar adaptations are found in a number of aquatic invertebrates belonging to quite different classes—such as bivalves and gastropods amongst the Mollusca—and their purpose is the same as that of the endostyle.

In the case of the lamprey, whose larval life is much longer than its adult existence, the endostyle is still present in the larva and functions in the same way as in *Amphioxus*, but now it has become restricted in extent and forms a pouch studded inside with groups of mucus-producing cells, which opens into the pharynx by a narrow opening. In the adult lamprey the pouch is cut off from the pharynx, and breaks up into a number of mucus-producing vesicles; no longer able to obtain iodine from outside, it must secrete it from the blood.

Here we have the familiar phenomenon of the gradual restriction of powers originally exercised by a wide stretch of tissue to a small portion of it, and the likewise familiar but totally inexplicable phenomenon of Nature learning to produce from the internal resources of an animal something originally obtained from outside. The gas in the air-bladder of fish is a case in point. Originally the air-bladder was a mere pouch of the pharynx, the use of which was to retain bubbles of air swallowed by the fish when the oxygen tension in the water was becoming low. But it also served to give the fish the power of adjusting its buoyancy, and in the majority of fish the air-bladder is shut off from the throat and the gas contained in it is secreted from the blood. Evans has recently shown that in fresh-water fish in which the connexion with the throat is maintained, only part of the contained air is obtained by swallowing; most of it is secreted by the blood.

The other endocrine organ of which the evolutionary history has been traced is the pituitary body, including both anterior and posterior lobes. This mysterious body has been credited with the production of at least six different hormones. In the ascidian tadpole, however, in which a brain vesicle, distinct from a spinal cord, first makes its appearance, the pituitary appears as a tube connecting the vesicle—not with the digestive system as our author states—but with the stomodæum or ectodermal hall-way to the mouth. At the metamorphosis, the part connected with the mouth becomes cut off from the rest and develops a number of glandular pockets. In a word, the pituitary body was originally nothing more than the anterior neuropore. In the primitive vertebrate, which as we have seen was originally a 'filter feeder', the current of water drawn in by the cilia of the gills must also have entered the neuropore, and the extreme front end of the nervous system was thus enabled to 'taste' its contents. It thus performed exactly the same function as is exercised by the 'osphradial' ganglia of bivalve Mollusca. Later it derived the substances which it 'tasted' from the blood. Thus the inmost nature of the endocrine organs, as of every other living organ, cannot be elucidated by its structure alone; we must also take into account its evolutionary history. E. W. MACBRIDE.

Scenting the Quarry

Hunting by Scent. By H. M. Budgett. Pp. xi + 122 + 22 plates. (London: Eyre and Spottiswoode, Ltd., 1933.) 25s. net.

EVEN a Poet Laureate would find difficulty in expressing the diversity and extent of the influence of fox-hunting. Farmers, breeders, saddlers, tailors, veterinarians, surgeons, painters, sculptors, poets, composers, to name but a few, have been affected in some way or another by Reynard the Fox; and through them, innumerable others are involved. When practical experience in hunting the fox is blended with a capacity and zest for hunting data, the chase involves the world of science When, in addition, an ex-Master of the Bicester and Warden Hill Hounds discloses keen ness, perseverance, humour, and a great kindliness, the resulting expression is a book which is not merely of scientific interest, but is also endowed with a charm that can only be described by the word English

The author has succeeded in writing a book "with the object of explaining the fundamental principles of scent in such a manner that they can be grasped by those who have not had the advantage of a scientific training ' The scientific fields and coverts surveyed can only be adumbrated here in part the significance of the sense of smell, conditions under which scent is good or bad, the effects of light, temperature humidity and wind, inhalation and exhalation by the soil special experiments and apparatus (for example the author's electric scent indicator) for determining scent conditions, the nature of trails followed by hounds the examination of scent trails left by different quarries over various surfaces, the distance over which scent can be detected by various animals, olfactory fatigue, the obliteration and neutralisation of scent tracks the microscopic examination of the odorous particles forming a track, the bearing of the sense of smell on animal behaviour Especially to a dog, smelling is believing", and canines communicate with each other by means of signal posts or scent telephones" as described by Seton

The wealth of subject-matter, whether gleaned from others or from the author's original observations and experiments, is attractively presented and briefly summarised at the end of each chapter The accompanying photographs and photomicrographs, especially the plates from original drawings by such a distinguished limner of the hunting field and connoisseur of the fox as is Lionel Edwards, R I, complete an ensemble forming a quite unique contribution to intellectual and æsthetic enjoyment

The author has proved beyond all doubt, by means of painstaking experiments, that there must be actual contact between the quarry and the ground, in order to produce a trail which can be hunted by a hound Thus, a trail of scent of bruised herbage is left when an inodorous weight is dragged along a field, a trail which a bloodhound is able to follow by scent alone after forty-eight hours "Hunting by Scent" includes many other interesting observations, and also many indications of problems as yet unsolved The author, artist and publishers have produced an interesting and enjoyable volume Perhaps not the least contribution to science lies in its stimulation to further exploration of the inexhaustible field of interest of which the sense of smell is the centre

J H K

"Vulgariser sans abaisser"

The Universe of Light By Sir William Bragg Pp xi + 283 + 26 plates (London G Bell and Sons Ltd, 1933) *12s 6d* net

WE can in England, look back on a long list of eminent men of science who, so far from disdaining any attempt to popularise knowledge, have spared no pains to bring home the truths of science to the layman, and the layman has not been inappreciative of these efforts A series of some half a dozen volumes clothed in red—the Manchester science lectures for the people—tells eloquently of the crowds who thronged to the Hulme Town Hall to hear Roscoe, Clifford, Rucker, Thorpe, Huxley and a score of other famous Victorians elucidate the scientific problems of the time in a way which may seem over serious to the lighter hearts of to day, but which, if numbers be any test, was admirably suited to the needs of their hearers These lectures, born of Roscoe's energy and drive were a dominating feature in the life of Manchester in the early 'seventies of the last century In London, Faraday had not long gone from the Royal Institution, Tyndall was at the zenith of his fame, and was irritating the Scots school of physicists by his solemn championship of Mayer The persistence of force was a phrase still heard, the specific heat of electricity had still some elements of novelty, and the "Descent of Man" was a best-seller It is all very interesting, and very crinoline-ish and it is something of a surprise to realise that Boyd Dawkins, doyen of that far away group of Manchester lecturers of the 'seventies, was taking an active part in a British Association meeting some six years ago

Manchester and London were then two foci of scientific learning So they are to day, and we of the nineteen thirties are specially privileged in being able to hear Sir William Bragg's almost magically easy unravelling of the complexities of modern optical science It was all very well, sixty years since, to explore the field of spectrum analysis, or to argue the question of the formula of water, the expositor of to day, faced with an array of photons, neutrons, diplons and positrons, has a different and difficult row to hoe Sir William accomplishes the feat in a characteristically genial and effortless manner, clinching his appeal to theory by admirably conceived experiments, and stimulating the interest of his hearers (and readers) by illustrations—the laws of perspective, Japanese mirrors, rearlight reflectors, the lustre of sateen, and so forth—which keep us constantly in touch with reality *Ars est celare artem*, and, as with Boswell's report of the famous dinner episode, it seems very easy until one tries to do it for one's self

The nature of light, the eye and vision, colour and its origin, the colour of the sky, polarisation, light from the sun and stars, Röntgen radiation, and, finally, the wave and the corpuscle—this outline of the topics treated in the book shows how wide a range is covered by these lectures, which are as delightful to read as they must have been to hear Reflection at a plane surface in the opening chapter, electron diffraction at the close of the book—it is a long and involved journey which we cover in less than three hundred pages, and there is not a dull moment on the way

But surely Eros is playing an unaccustomed rôle in astronomy!

ALLAN FERGUSON

Short Reviews

Proceedings of the American Society for Psychical Research Vol 22 *The Margery Mediumship—The 'Walter' Hands a Study of their Dermatoglyphics* By Brackett K Thorogood Pp xix+228+123 plates (New York American Society for Psychical Research, 1933) n p

THIS volume is a detailed account of certain alleged supernormal phenomena which occur in the presence of the medium Margery (Mrs L R G Crandon, of Boston Mass) They consist mainly in the impressions of thumbs in dental wax, and an account by Dr R J Tillyard of the conditions under which they are produced was printed in NATURE for August 18, 1928, pp 243 ff, where Fig 6 is a photograph of one of these impressions In the leading article of the same date it was pointed out how, assuming the accuracy of Dr Tillyard's observations, we had little reason to deny the medium's power of producing the thumb prints of anyone either living or dead Since then the claim has been made that such prints of living persons (for example, Sir Oliver Lodge) have been produced, but the most interesting development is the alleged discovery that the very large number of prints said to have been made by Walter (the deceased brother of the medium and her spirit control) are in reality identical with those of a person living in Boston, who formerly attended a number of sittings and first suggested to Margery' the use of dental wax as a convenient compound

In the case of the right thumb print some forty points of similarity are admitted by both sides in the case of the left, identity appears to be absolute, although the president of the American Society for Psychical Research now claims that the examples printed previously in the Society's publications were not authentic, being substitutions on the part of one of the leading investigators, through carelessness they were not noticed at the time

It is clearly impossible here to evaluate the evidence or even to discuss it, since the data on which the various arguments are based are themselves suspect Indeed the report illustrates with startling clarity the reasons why the scientific world remains aloof For from whatever point of view this report may be regarded it is not only the medium but also the officials themselves who are being denounced as incompetent and guilty of a series of dubious manœuvres

Encyclopædia of Psychic Science By Dr Nandor Fodor Pp lv+416 (London Arthurs Press, Ltd, 1933) 30s net

THIS book, in spite of its somewhat provoking title is a notable addition to the literature of psychical research The author, who, it may be said, is clearly inclined to believe far more than the evidence suggests, has nevertheless succeeded in putting together a mass of material which includes many facts pointing to conclusions not in accordance with his own The impartiality he displays in printing these data is highly commendable, and some good examples of it may be seen in the articles on Eldred and Duguid

In his preface Dr Fodor stresses the difficulties of compiling an encyclopædia of this kind, and states that he should have been assisted by an editorial committee In this we are inclined to agree Although he is fully capable of presenting his material, he is naturally not quite fully acquainted with it Thus the article on "ectoplasm" (apart from a few amazing examples of credulity) is an excellent summary, whilst that on the poltergeist is very poor In the latter article there are several cases from newspapers whereas there is no word of Dibbesdorf, of Stans, or of Oakland, California! Similarly, in the body of the text we find omissions for which it is not easy to account Among these we would mention Farmer Riley, Abraham Cummings, Nicolai, Staudenmaier and the Gallery of Spirit Art Although actual mistakes are readily excusable in a work of this size, it is curious that Dr Fodor should make Patience Worth masculine, Mrs Abbott and Lulu Hurst examples of "electric phenomena", and Imoda an author of a book on psychic photography

Apart from criticisms of this kind, the book is likely to be of great service to those who wish to gain a general view of some particular aspect of psychical research or to revise a previous acquaintance The author must certainly be congratulated on the trouble he has taken, although he would be well advised to omit certain of the photographs in any later edition One of these is instructive It shows the medium Rudi Schneider when supposed to be controlled by two observers His right hand is apparently not held in any way It is a good example of what occurs in psychic science'

A Description of some Trees, Shrubs and Lianes of Southern Rhodesia By E C Steedman Pp xxi + 191 + 92 plates (Gwelo, Southern Rhodesia Miss E C Steedman, Norfolk Farm, 1933) 7*s* 6*d*

Miss Steedman is to be congratulated on having produced a book on the trees, shrubs and lianes of Southern Rhodesia which should be of great service to residents in the colony and should stimulate an interest in the vegetation of the country and also, it is to be hoped, serve a useful purpose in arresting the destruction of the indigenous timber

Miss Steedman has worked under considerable difficulties, being away from sources of botanical literature, and, in consequence, some errors in the nomenclature of the plants to which she refers have crept in This, however, is a minor point which can easily be set right when she has had an opportunity of consulting authorities and literature, should a second edition of the book be called for

Thanks to the keys and descriptions, it should be possible for anyone interested in plants to be able to identify the native species, and this will be considerably facilitated by the line drawings which are, on the whole, quite useful, though in some cases they have suffered a little in reproduction

From the purely botanical point of view, some criticisms can be offered, but the main point about the book is its value to residents in Southern Rhodesia This is enhanced by the inclusion of the native names of the trees and shrubs wherever it has been found possible to assign them to a definite species

As the work of an amateur with a real love of her subject, the book certainly deserves high commendation

A Standard Classified Nomenclature of Disease Compiled by the National Conference on Nomenclature of Disease Edited by Dr H B Logie Pp xvii + 701 (New York The Commonwealth Fund, London H K Lewis and Co, Ltd, 1933) 21*s*

The National Conference (of the United States of America) on Nomenclature of Disease was formed with the object of solving the confusion due to the absence of a standard nomenclature of pathological conditions It has now produced the system described in this book, a dual method of classifying disease, based on the two features of topography and etiology The topographical classification gives a code number to every region of the body in which disease can be clinically located, the first numeral indicates the body system, the second the organ, and the third the part of the organ involved The etiological classification similarly divides all causal factors into groups, which are further subdivided Any disease or injury has thus a number indicating location hyphened to another indicating cause The system also allows expression in symbols of obscure, undiagnosed or partially diagnosed conditions

The book can be strongly recommended to the records departments of hospitals, and as the method advocated requires accurate expression of a diagnosis, its adoption would do immense good in stimulating precise thinking and avoidance of ill defined terms on the part of clinicians

A Bibliography of Differential Fertility in English, French and German Edited by Eldon Moore on behalf of Commission II of the International Union for the Scientific Investigation of Population Problems Pp vi + 97 (London Dr E C Rhodes London School of Economics, 1933) 2*s*

The compiler of this book is not a biologist but a journalist who, like many other intelligent lay men, has been attracted by the lure of biology and the problems which it involves For a considerable time he acted as editor of the *Eugenics Review*, the organ of the Eugenics Society He has produced in this book a most valuable compilation of papers and books dealing with the problems of fertility both in man and animals

An Elementary Introduction to Physics Descriptive, Experimental and Historical By Edgar Booth Pp 465 + xvi (Glebe, N S W Australasian Medical Publishing Co, Ltd, London H K Lewis and Co, Ltd, 1933) 5*s* net

A book from Australia is to be welcomed, as it is likely to put forward fresh points of view which give hints to teachers of elementary physics in Great Britain This book is quite elementary in character and practical in type, and the author has avoided the mistake of introducing the ideas of modern physics at this early stage

Précis d'électricité théorique Par Dr Léon Bloch Deuxième édition, revue et corrigée Pp vii + 476 (Paris Gauthier Villars et Cie, 1933) 50 francs

This treatise gives an account of classical electrical theory, with modern notation and the use of vector analysis where necessary It is comprehensive and clear and ends with two important chapters, one on the electrodynamics and the other on the optics of bodies in motion

Aluminium surfaced Mirrors

By Dr H Spencer Jones F R S

THE mirrors in astronomical reflecting telescopes were formerly made of speculum metal—a hard alloy of copper and tin capable of taking a fine polish and having a fairly high reflecting power Speculum metal mirrors have been entirely replaced by glass mirrors coated on the figured surface with a thin film of silver The silvered surface when fresh has a high reflecting power for wave lengths greater than 0 375 μ at this wave length the reflecting power is 0 80 at 0 400 μ it is 0 85 at 0 450 μ it is 0 90 and at 0 700 μ it is 0 95 On the short wave length side of 0 375 μ the reflecting power falls off rapidly owing to selective absorption to a minimum value at about 0 315 μ of only 0 04 This is a serious disadvantage when observations are required in the ultra violet region Thus for example at a wave length of about 0 325 μ the atmospheric transmission is 0 50 but the reflecting power of silver is only 0 12 In a reflecting telescope the image is normally produced by reflection at two silvered mirrors so that the loss by the selective absorption of the silver is much greater than the above figures indicate

These figures refer to a freshly deposited silver film But the reflecting power steadily falls owing to gradual oxidation or to tarnishing due to the action of sulphur dioxide in the atmosphere Where such atmospheric contamination is prevalent the reflecting power falls rapidly At even the most favourable sites however there is a gradual fall in reflecting power so that the mirrors must be periodically dismounted and resilvered The silver film is easily deposited chemically and though the silvering process itself is not difficult any satisfactory method of making it unnecessary would be welcomed for it would imply that the decrease in reflecting power—which necessitates lengthened exposures and is particularly troublesome in some photometric work—had been eliminated Coating the silver film with a thin film of colourless lacquer has been tried but the optical perfection of figure is almost inevitably impaired

The development of a method of coating glass surfaces with a film of aluminium and the unexpected properties of such films are therefore of the greatest importance for astronomical observation For wave lengths greater than about 0 40 μ the reflecting power of an aluminium film is somewhat less than that of a freshly deposited silver film The difference is not however very great at a wave length of 0 50 μ the reflecting power of the aluminium film is 0 88 as compared with 0 91 for silver at 0 60 μ the relative values are 0 89 and 0 93 at 0 70 μ 0 87 and 0 95 The reflecting power of a silver film after a short period of use would soon fall below that of a freshly deposited aluminium film To the short wave length side of 0 40 μ the aluminium film is greatly superior to the silver film as it does not show the band due to selective absorption At 0 35 μ its reflecting power is 0 85 as contrasted with 0 70 for silver at 0 30 μ (near the limit of atmospheric transmission) it is 0 83 as compared with 0 08 for silver For observations in the ultra violet region the aluminium film is therefore very much superior to the silver film

The aluminium films have other important advantages A freshly deposited film on exposure to the air immediately oxidises and the oxide coating forms a protective layer which prevents the film from tarnishing It is stated by Dr J Strong who has developed at the California Institute of Technology a technique for the coating of mirrors with aluminium that concentrated nitric acid can be poured on the mirror with immunity Nevertheless the film can be readily dissolved by dilute hydrochloric acid to which a trace of some copper salt has been added Sulphur dioxide in the atmosphere does not tarnish an aluminium film or at most at a very slow rate A small mirror partly coated with silver and partly with aluminium has been exposed at Greenwich where conditions as regards sulphur in the atmosphere are bad until the silver film had become completely yellow The aluminium film was apparently unaffected Dr Strong mentions that the mirrors of a telescope aluminised in October 1932 and constantly used since show as yet no signs of tarnish

Aluminium films are more strongly adherent to glass than silver films Dr Strong states that a piece of adhesive tape may be pressed on to the film and then stripped off without loosening the metal from the glass This tenacity makes it possible to clean the surface of dust or other contamination by washing with soap and water It is also stated that aluminised mirrors do not scatter light

The largest mirror yet coated with aluminium is the 36 inch mirror of the Crossley reflector of the Lick Observatory which was coated in December 1933 When this mirror was coated with silver a long exposure spectrogram ended at about 0 325 μ An equal exposure with the aluminised mirror gives a spectrogram extending to about 0 300 μ An exposure of only 20 seconds on the star Orionis of magnitude 2 9 gave a spectrogram measurable to about 0 310 μ The atmospheric ozone absorption lines in the ultra violet can be photographed in a few seconds Dr W H Wright states that comparison of photographs of the north polar sequence before and after the aluminising indicated that the general reflectivity had been stepped up by 50 or 60 per cent this illustrates the effect of tarnishing of a silver film even under the favourable atmospheric conditions on the summit of Mount Hamilton

Aluminium is a difficult metal to sputter by cathode disintegration, and the most effective method of depositing the aluminium films has been found to be by an evaporation process in a high vacuum of the order of 0 0001 mm of mercury The aluminium is heated in small tungsten coils arranged opposite the mirror to be coated, the aluminium evaporates and condenses on the face of the mirror The low pressure enables each atom of aluminium, after evaporation, to travel in a straight path to the mirror with small probability of collision with other atoms In coating the mirror of the Crossley reflector, twelve helical tungsten coils were arranged round a 36 inch circle at a distance of 18 inches from the mirror Each coil had 10 turns and to each turn a U shaped aluminium wire, $\frac{3}{8}$ inch long and $\frac{1}{32}$ inch diameter, was clamped Each coil was connected in turn to the electrical supply, at a voltage of 20 volts the entire process of distilling from the twelve coils requiring about three minutes The mirror was placed on brass bars fastened to a reinforced steel bedplate, one inch in thickness, this arrangement enabled gases underneath the mirror to be pumped out easily The bell jar covering the mirror was of $\frac{1}{4}$ inch sheet steel, stiffened at the bottom by a rolled angle iron, and machined to give a perfect plane surface A lead fuse wire was pressed into a circular groove in the bedplate, at the bottom of the bell jar, the angle iron was bolted down by 24 bolts exerting a force of 50 tons on the fuse wire gasket, to which atmospheric pressure on exhausting added another 10 tons

The mirror surface must be absolutely clean for a satisfactory coat The most satisfactory way of securing the requisite cleanliness with a large mirror was by removing foreign material with an electric discharge from a central electrode With the arrangements used for the Crossley mirror a very uniform thickness (about $\frac{1}{10}$ μ) of coat was obtained

Dr Strong finds that it is possible to coat speculum metal gratings with aluminium, the reflectivity is increased about 50 per cent for visible light and by an even greater extent in the ultra violet The higher orders of spectrum also become relatively brighter The definition was found not to be impaired by the coating The coat can be dissolved by caustic potash, which does not attack the speculum metal This application of the process should prove of value in the laboratory as well as in astronomical spectroscopy

It is hoped that apparatus for aluminising telescope mirrors up to a size of 36 inches diameter will be available in Great Britain before long Some experimental work has been in progress, and a piece of plate glass coated with aluminium was on view at the meeting of the Royal Astronomical Society on March 9

The Lyochromes: a New Group of Animal Pigments

By PHILIPP ELLINGER and WALTER KOSCHARA, Dusseldorf

IN the observations of living animal organs by the 'intravital microscope'[1] it was noticed that cells of some organs of the animal not previously treated with fluorescent dyestuffs contained substances which were excited by ultra violet light to give a characteristic yellow green fluorescence Such substances were chiefly found in the liver cells and in the epithelial cells of the first convoluted tubules of the kidney of all the animals examined, including horses, oxen, dogs, cats, rabbits, guinea pigs, rats, mice, frogs, etc In the liver two other groups of cells could be found which were fluorescent, but far less strongly, the Kuppfer star cells, shining with a dull orange yellow fluorescence, and single cells, showing a reddish fluorescence, near to the blood vessels The two groups last named have no connexion with the pigments with which this article deals The intensity of the fluorescence of the epithelial cells of the kidney, and also of the liver cells, appeared to be diminished when the animals (rats) were fed on a diet free from nitrogen, and to be augmented after the administration of urea The suggestion arose that these pigments might have some connexion with the formation or the excretion of urea, because they were found in great quantity just at the sites of the intensive formation and excretion and therefore of great concentration of urea Since it appeared likely that these pigments had great physiological importance we tried to isolate and identify them

Animal pigments have been for a long time an object of interest to physiologists and chemists Especially by the researches of chemists, knowledge of them has been greatly increased during recent decades The animal pigments hitherto known are nearly all soluble in neutral organic solvents under suitable conditions, and this property was highly important for their isolation and recognition Only a few of the animal pigments previously known are strongly fluorescent, and their fluorescence differs in colour from that of the pigments now found in the kidney and the liver

The first attempts at extraction showed that our pigments were completely insoluble in the usual indifferent solvents, such as ether, chloroform, benzol, ligroin, and that, on the other hand, they were soluble in water As a guide in our attempts at isolation we used the characteristic yellow-green fluorescence, which clearly revealed even extremely small quantities, and which was further characterised by the fact that it was to a high degree dependent on the *p*H, being changed reversibly to a violet fluorescence by both acids

and alkalis Further, the fl
destroyed by light The solutions of our pigments are coloured orange yellow in stronger, yellow in weaker concentrations The pigments are resistant to acids, but they are destroyed by hot alkalis

After having determined the solubility of the pigments in water we proceeded, in the first instance, to mince organs fresh from the slaughter house (livers and kidneys of horses and oxen) or the same organs from recently killed dogs, in which we had determined the presence of the pigments by intravital microscopy, and, after mincing, we extracted such materials with water The watery extract was freed from albumen sugar and other contaminating substances and concentrated It appeared from these attempts that the yield of raw pigments from both organs was very small We searched therefore for another source of these pigments, promising a better yield, and found it in whey We convinced ourselves by tests that the pigments of whey correspond to those of the kidney and the liver, in respect of their fluorescence and their reactions to acid, alkali and light Having found pigments with these properties in many different materials in our first researches we concluded that we were dealing with a new group of substances of wide distribution, and we named them Lyochromes

The pigments of whey have been described recently by Bleyer and Callmann[2] and by Gerngross and Schulz[3] From the work of Bleyer and Callmann the difficulty of isolating such substances is evident Bleyer and Callmann could, indeed, greatly concentrate these substances but they were unable to isolate them They came to the conclusion that the pigment of whey belongs to the oxyproteinic acids, a conclusion which as we shall see later, cannot be maintained Whey first became useful as a raw material when we had found the right adsorbents for concentrating and isolating the pigments Fuller's earth was found to be the best adsorbent, and the adsorption v most successful from a slightly acid solution, such as that natural to whey, which always has an acid reaction due to lactic acid

From the adsorption on fuller's earth, which was washed several times with water and alcohol, the pigments were eluted by mixtures of pyridine and water[4] In this manner we obtained concentrates of pigments, which were purified by precipitation of contaminating substances, and which could be induced to crystallise from watery solution

We were able to isolate five crystalline coloured substances, which we described as 'Lactoflavins *a*-*e*'[5], and which differ from one another in constitution, crystalline form, solubility and intensity of the colour in solution It is possible, perhaps even likely, that the chromogen component in all these pigments is identical By careful removal of impurities we obtained at first three crystalline pigments, lactoflavins *a*, *b* and *c*, which are distinguished by slight solubility in water and in mixtures of concentrated acetic acid and acetone from the other lactoflavins, *d* and *e* They differ from one another in crystalline form, basicity and percentage composition as follows —Lactoflavin *b* (small hexagonal tablets, C 35 7, H 3 3 N 32 0), and lactoflavin *c* (needles of the form of a dragon fly's wings C 35 7, H 2 6 N 31 3) have a similar composition On the other hand, lactoflavin *a* (crystals in nodular aggregates, C 33 5, H 4 0, N 21 6), differs from the other two, especially by its lower content of nitrogen Lactoflavins *b* and *c* have a percentage composition close to that of uric acid (C 35 7, H 2 4 N 33 3), but differ from uric acid in their greater solubility in water and in the property of not being precipitated by ammonium chloride Lactoflavins *a* *b* and *c* have no melting points The crystals are coloured orange red They dissolve in water to give orange coloured solutions yellow when more dilute The solutions have a yellow green fluorescence It was not possible to fix the molecular weights The watery solutions lose their colour by heating with alkali with evolution of ammonia The three pigments give the murexide test

From 100 litres of whey we obtain in the most favourable case, perhaps 10 mgm of each of the three pure lactoflavins *a*, *b* and *c* Much loss is caused by the purification of the crude crystals, a procedure in which one must avoid temperatures above 60° For it was evident that on heating the watery solutions of these lactoflavins a decomposition occurred This decomposition yields a colourless substance, very difficult to dissolve in water, of a purin character and a pigment which remains in the solution, and which shows all the qualities of the Lyochromes The pigment produced by this cleavage, which we call lactoflavin *d* has been isolated by us from the mother liquors of the lactoflavins *a*–*c*, as a pigment very much more soluble in water than the Lyochromes hitherto described It is not strictly proved as yet, that this pigment from the mother liquors is identical with that formed by the decomposition of the slightly soluble Purin Lyochromes

Lactoflavin *d* crystallises in the form of reddish yellow needles, which melt at 270° 273° with complete decomposition The data per cent given by analysis (C 52 69, H 5 84, N 14 38) indicate the formula $C_{16}H_{20}O_6N_4$, or $C_{17}H_{20}O_7N_4$ The reddish yellow watery solution of lactoflavin *d* fades, on heating with alkali, to a pale yellow colour, without appreciable evolution of ammonia The murexide test gives a negative result with this pigment

In isolating lactoflavin *d* we have found a further crystalline pigment, which is precipitated in microscopic aggregates and which is called lactoflavin *e* Its solubility in water and its content of nitrogen (24 per cent) give it a position between the lactoflavins *a*–*c*, on one hand, and lactoflavin *d* on the other The lactoflavin *e* gives a positive murexide reaction, but only with chlorate and hydrochloric acid ('forced murexide test')

By a procedure corresponding to that of Warburg and Christian[6], which will be quoted later, a decomposition product can be obtained from the Lyochromes of whey by irradiation of their alkaline solutions which differs from the Lyochromes by its solubility in chloroform This substance crystallises in the form of reddish yellow small woolly needles it melts with decomposition at 315° 317 It is slightly soluble in hot water also in ammonia and is easily soluble in dilute sodium hydroxide The solutions are fluorescent in the same way as the Lyochrome solutions The results of analysis of this product of photochemical decomposition (C 61 97 H 5 19 N 20 58 per cent) indicate the formula $C_{14}H_{14}O_2N_4$ Its properties make it likely that it is at least very nearly connected perhaps identical with the substance formed by light from the Lyochromes of yeast obtained by Warburg and Christian If we accept for lactoflavin *d* the formula $C_{17}H_{20}O_6N_4$ and we compare it with the formula of the photochemical cleavage product of lactoflavin *d* a difference of $C_3H_6O_4$ is found

In the transformation of lactoflavin *d* by light we must probably reckon with a reaction proceeding in several steps At first H_2O will be split off and then a further substance free from nitrogen and finally a transformation of the nitrogen containing coloured molecule will take place On this assumption one may divide the difference between the formulæ of lactoflavin *d* and the photochemical cleavage product $C_3H_6O_4$ into H_2O (water) and $C_3H_4O_4$ (malonic acid ?) Not only the higher melting point of the cleavage product but also its behaviour to oxidation with chromic acid indicate that its molecule is more stable than the molecule of lactoflavin *d* While by oxidation with chromic acid 8 mols of carbonic acid are formed from lactoflavin *d* in about one hour and a half when the reaction comes to an end by the same treatment of the cleavage product only about two mols of carbonic acid are evolved in the course of six hours without the formation of carbonic acid being completed In contrast to the lactoflavin *d* we can extract with ether from the oxidation products of the pigments soluble in chloroform a substance which corresponds completely to the Lyochromes with respect to its colour and fluorescence but in which nitrogen can no longer be demonstrated by the test of Lassaigne The search for the constitution of the Lyochromes must start with such decomposition products

An important property of the Lyochromes which must be expressed in the constitutional formulæ is the reversible reduction to a leuco substance These leuco substances are formed for example by a biological process if whey is left standing for some time so that it becomes covered with a film of microbes The liquid under this film does not show the Lyochrome fluorescence but the fluorescence can be restored immediately by shaking it with air Chemically the leuco substances can be obtained by reduction with hydrosulphite with hydrogen sulphide in a weakly alkaline solution and also with titanous chloride Of other chemical properties of the Lyochromes in the first place their great stability to oxidising agents must be mentioned The Lyochromes are not attacked by concentrated nitric acid bromine water or hydrogen peroxide Hydrogen peroxide in presence of iron salts and cold permanganate attacks them only slowly but they are very quickly destroyed by hot permanganate

Hitherto the existence of Lyochromes has been determined by ourselves in animal organs in whey and in urine The wide distribution of this new group of natural pigments is further evident from the papers of Warburg and Christian and also of Kuhn Gyorgyi and Wagner Jauregg These investigators detected yellow green fluorescent pigments of Lyochrome character in yeast in very high concentration in cultures of the lactic acid bacterium in muscle in white of egg and also in vegetable materials Warburg and Christian found in the course of their search for the so called second respiratory ferment pigments of Lyochrome character and they were able to show that the combination of a yellow green fluorescent pigment with a carrier of high molecular weight represents this iron free respiratory ferment itself This respiratory ferment is therefore not dialysable in contrast to the Lyochromes of whey We have found that in contrast to that of cow s milk the pigment of human milk is also fixed on a carrier probably on albumin Lastly Kuhn Gyorgyi and Wagner Jauregg have been led to this new sphere of pigment investigation by researches directed to the isolation of the vitamin B_2 Vitamin B_2 appears to belong to the Lyochromes To this statement we must make the reservation that the crystallised Lyochrome which in the opinion of these investigators are the cause of the vitamin effect require for the production of their effect on growth to be supplemented by a substance chemically not yet defined (vitamin B_4) The crystallised pigments which Kuhn Gyorgyi and Wagner Jauregg were able to isolate first from white of egg and then from whey are similar or identical with the lactoflavin *d* isolated by ourselves from whey The possibility cannot be denied that the different natural Lyochromes may consist of the same pigment component united with different other substances acting as carriers

We find accordingly in whey Lyochromes of very different molecular dimensions Including the substances obtained by decomposition of the original Lyochromes we can at present construct the following series arranged in order of molecular dimensions

(1) The pigments united to a non dialysable carrier (albumin ?) from human milk corresponding to the second respiratory ferment of Warburg and Christian

(2) The pigments in combination with purin substances (lactoflavins *a–c*)

(3) A single pigment (lactoflavin *d*) corresponding to the ovoflavin and the lactoflavin of Kuhn Gyorgyi and Wagner-Jauregg

(4) The photochemical cleavage product that

is, the pigment without H_2O (water) and $C_3H_4O_4$ (malonic acid ?), corresponding to the cleavage product from yeast of Warburg and Christian

(5) The oxidation product of the photochemical cleavage product, soluble in ether (free from nitrogen ?)

Warburg and Christian have described the evolution of urea from their photochemical cleavage product by treatment with alkali, by which means the remaining substance, $C_8H_{10}O_2N_2$, loses its whole power of fluorescence and all but a small remnant of its colour It must be accepted that in this treatment an intramolecular transformation of the remaining substance also takes place , for our probably nitrogen free oxidation product, obtained from the product of photochemical cleavage, still possesses fluorescence and colour to such an extent that the nitrogen content is very unlikely to have any connexion with these properties

The three starting points of the researches leading to the discovery of the new group of animal pigments—namely, the functions of the liver and the kidney, the respiratory ferment, and the action of vitamin B_2—together indicate the great physiological importance of this new class of pigments While the function of the Lyochromes as respiratory ferment is completely explained, their character as vitamin B_2 still requires further investigation, since in the researches so far made their effect as vitamin B_2 was evident only with the addition of chemically unknown substances The physiological significance of the occurrence of Lyochrome in the kidney and the liver is still quite unknown On the respiration of normal tissue cells Lyochromes have no effect, as we ourselves, and also Wagner Jauregg and Ruska[8], have observed On the other hand, Stern and Greville[9] found that mammalian red blood corpuscles, which have practically no intrinsic respiratory activity show a significant increase of oxidation in the presence of Lyochrome It is very probable, however, that the substances used in these experiments as Lyochromes were not of that character , for, according to the investigations of one of us on the Lyochromes of the urine, the Urochrome used by Stern and Greville for their respiration experiments has no Lyochrome properties

To summarise The Lyochromes are characterised by the following qualities (1) solubility in water , (2) red to orange colour of the crystals, and orange to yellow colour of their watery solutions , (3) yellow green fluorescence , (4) extinction of this fluorescence by acid and alkaline reactions , (5) reversible reduction to leuco substances , (6) stability against oxidising agents

The chemical investigation of the group, in spite of the small concentration of the Lyochromes in organic materials, has already advanced so far that in the near future we may expect that their chemical structure will be revealed, and that a knowledge of new relations between chemical constitution and physiological action will be afforded thereby

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[1] The method of intravital microscopy has been described by Ph Ellinger and A Hirt in the *Zeitschrift für Anatomie und Entwicklungsgeschichte*, vol 90 p 791 1929 and in Abderhaldens Handbuch der biologischen Arbeitsmethoden vol 5 11, p 1753 1930 It permits living animal organs to be examined with the strongest microscopical magnifications by injecting the animal with fluorescent dyestuffs With ultra violet illumination these dyes provide by fluorescence in the cells themselves the light required for visible illumination of the microscopical picture

[2] Bleyer and Callmann *Biochem Z* 155 54 1925

[3] O Gerngross and M Schulz *Milchwirtschaftliche Forschung* 6 567 1928

[4] Details of this procedure as well as of further chemical operations are described in our publications Ph Ellinger and W Koschara *Berichte der Deutschen Chemischen Gesellschaft* 66 315 808 1411 , 1933

[5] We had made an agreement with R Kuhn, P György and Th Wagner Jauregg who worked over the same field and who called their substances Flavins , to call the whole group Lyochromes and their single specimens Flavins with the addition of the names of the materials of origin so that the Flavin from milk is called Lactoflavin

[6] Warburg and Christian *Biochem Z* 267 492 1933

[7] R Kuhn P György and Th Wagner Jauregg *Ber Deutschen Chem Gesell* 66 317 576 1034, 1577 1933

[8] Th Wagner Jauregg and H Ruska *Ber Deutschen Chem Gesell* 66, 1298 1933

[9] K G Stern and G D Greville *Naturwissenschaften* 23 720 1933

Obituary

Prof F Ll Griffith

FRANCIS LLEWELLYN GRIFFITH, whose death at the age of seventy one years occurred on March 14, was, like a number of other distinguished Englishmen, the son of a clergyman, the Rev John Griffith, who was for many years rector of Sandridge, Herts, and a mathematician of some repute After being educated at Brighton College, Sedbergh and Highgate, he came up to Oxford as a scholar of Queen's College, where, under the influence of Prof A H Sayce, he began those studies which were destined to win him later a world-wide fame He took his B A degree in 1884, and during the winter seasons of that and the three following years he was engaged in excavation and other research work in Egypt under the leadership of Petrie and Naville For some months of the season 1886–87 he was busy copying the inscriptions in the tombs of the First Intermediate Period and Middle Kingdom at Asyût and Dêr Rîfeh His publication of these texts ("The Inscriptions of Asyût and Dêr Rîfeh", 1889) not only shows that even at this early date he had acquired a sound knowledge of Middle Egyptian, but already displays that scholarliness and meticulous accuracy which are so characteristic of all his subsequent work

From 1888 until 1896, Griffith was an assistant in the Department of British and Mediæval Antiquities in the British Museum In 1892 he was made assistant professor of Egyptology at University College, London, a post which he retained until he was appointed reader of Egyptology at Oxford in 1901 During those years his output was remarkable both for quantity and quality, its crowning achievement being the publication in two volumes of Petrie s great find of papyri at Kahun and Gurob Most of these are documents written in the cursive business hieratic of the Middle Kingdom, a script of which there had hitherto been found few, if any, examples In his mastery of this difficult script and in his interpretation of the contents of the documents, Griffith showed that he possessed that rare gift—real genius Many years have passed since those two volumes appeared, and there has been a great advance in our knowledge of Middle Egyptian grammar and syntax, but even so, Griffith's translations and transcriptions need comparatively few corrections

For the next ten years or so Griffith devoted himself primarily to the study of Demotic, and by the end of that period was the foremost Demotic scholar in the world His ' Stories of the High Priests of Memphis" (1900) the Demotic Magical Papyrus of London and Leyden , which he produced in collaboration with Sir Herbert Thompson (1907–9), and above all his Catalogue of the Demotic Papyri in the Rylands Library (1909) placed Demotic studies on a new footing and gave them an interest which, in the minds of some of us at any rate, they had hitherto seemed to lack

About the year 1907, Griffith found opportunity for winning laurels in a new field Excavations in the Sudan and Lower Nubia were producing inscriptions in the Meroitic script hitherto undeciphered, and the finders handed them over to him to investigate After a few years of intensive study, he could decipher the script and had advanced far towards a complete understanding of the language

In due course Griffith turned back to Demotic and was actually engaged at the time of his death in the publication of the Demotic inscriptions occurring in the temple of Philae and in the temples of Lower Nubia, a great and most important undertaking

In the winter season 1910–11, Griffith and his wife conducted excavations on behalf of the University of Oxford in Lower Nubia, and they continued these activities until the winter season 1913–14 In 1922 and 1923 they excavated for the Egypt Exploration Society at El Amarna Twice since then they have excavated in the Sudan, the site of their last campaign (1930–31) being Kawa, where they unearthed three temples, one of which had been founded by Tirhaqa At Kawa, beside several large stelæ bearing inscriptions of great historical interest, they found a number of reliefs and statues and a quantity of other antiquities, some being of considerable artistic merit

In 1924, in consideration of his services to Egyptology and to the University of Oxford, Griffith was given the status of professor, and, though he resigned the chair in 1932, he acted as deputy professor until the late Prof Peet was transferred from the University of Liverpool to succeed him in October 1933 Griffith was a D Litt of Oxford, an honorary fellow of Queen's College, a fellow of the British Academy and also of the Society of Antiquaries, an honorary LL D of the University of Aberdeen and an honorary D Phil. of the University of Leipzig He was a corresponding member of the Royal Academy of Sciences at Berlin, and a foreign associate or corresponding member of many other famous learned societies in Europe

He was twice married, and his second wife, who has rendered him notable assistance in his excavations in Egypt, Lower Nubia and the Sudan and in the production of many of his publications survives him

Griffith was a man of wide interests Beside a profound knowledge of Egyptology in all its branches he was well acquainted with the archæology of his own country and of foreign countries other than Egypt He was very fond of music and was a good naturalist and botanist He was a delightful companion for a country walk pointing out and discussing any interesting flower or plant that he observed growing in hedgerow or field and he knew every bird by its notes It should here be stated that his great knowledge of the birds fish and other animals of Egypt is made manifest in many of his books and articles A charming trait in his character was his love of children, who found in him an ideal companion He would take them round his garden and talk to them about the birds and plants and the creatures living in stream or pond Small children, frightened of strangers in general, took to him immediately and, when next he appeared on the scene, welcomed him with open arms

His was a full life and he accomplished much He died, as all would wish to die, in full possession of all his faculties and with his mind occupied to the last in the work he loved

ALYWARD M BLACKMAN

DR H S WASHINGTON

WITH the death of Dr Henry Stephens Washington on January 7 at the age of sixty six years, petrology has suffered the loss of one who, for the past forty years, has worked with distinction and has contributed greatly to the advancement of the science

Henry Stephens Washington was born at Newark, New Jersey, on January 15, 1867, and, after due preparation, he proceeded to Yale where he obtained, in 1886, the degree of B A with special honours in natural sciences After two years of post graduate work he graduated M A in 1888 The next four years were spent in travelling in the West Indies, Europe, Egypt, Algeria and Asia Minor, parts of the four winters and springs being spent in Greece where he became a member of the American School of Classical Studies In the latter capacity he assisted in and conducted excavations at Plateae, Argos and Phlius

Between 1891 and 1893 Washington studied petrology under Zirkel at the University of Leipzig and obtained his doctorate with a thesis on 'The Volcanoes of the Kula Basin in Lydia After wards he was assistant in mineralogy at Yale for a short time and continued his petrographical researches in Europe and America From 1906 until 1912 he practised as a consulting mining geologist and in 1912 he was appointed petrologist to the Geophysical Laboratory in Washington a position which he still held at the time of his death

Dr Washington travelled extensively and the results of his geological petrological and volcanic studies in Europe North America Brazil Asia Minor and the Hawaiian Islands are incorporated in numerous publications His devotion to the chemical side of petrology was the ruling factor in his career and his skill as an analytical chemist and petrographer together with an unfailing interest in volcanic processes and rocks have contributed greatly to our present knowledge of modern lavas At the same time his scientific activities embraced a much wider field and his investigations ranged from archæological subjects to problems of the earth's interior

In 1904 he published his Manual of the Chemical Analysis of Igneous Rocks the fourth edition of which appeared in 1930 He was joint author with Cross Iddings and Pirsson of The Quantitative Classification of Igneous Rocks published in 1903 and author of the Chemical Analyses of Igneous Rocks which was issued by the United States Geological Survey as a Professional Paper in 1903 and in an enlarged edition in 1917 An enormous amount of work is represented in this compilation of which the importance from a petrological point of view cannot be over estimated it must always remain an admirable memorial to its author

It is impossible to deal adequately with Washington's scientific publications which form an imposing list but among the more important may be mentioned The Roman Co Magmatic Region (1906) The Deccan Traps and other Plateau Basalts (1922) 'The Petrology of the Hawaiian Islands (1923–1928) and The Composition of the Earth's Crust (1924 in collaboration with Dr F W Clarke)

Dr Washington's scientific attainments were widely recognised both in the United States and in Europe He was a foreign member of the Geological and Mineralogical Societies of London of the Paris Academy of Sciences and of the Academies of Science of Norway Turin and Modena and of the Royal National Academy of the Lincei (Rome)

With his death geology must mourn the passing of a great figure in the petrological world

We regret to announce the following deaths

Prof J R Ainsworth Davies formerly principal of the Royal Agricultural College Cirencester on April 7 aged seventy two years

Prof A B Macallum F R S formerly professor of biochemistry in the University of Toronto lately professor of biochemistry in McGill University on April 5 aged seventy four years

Sir Frederick Palmer K C M G C I E president of the Institution of Civil Engineers in 1926 27 who was a well known bridge and harbour engineer on April 7 aged seventy two years

Prof Sydney H Vines F R S formerly Sherardian professor of botany in the University of Oxford president of the Linnean Society of London in 1900–4 on April 4 aged eighty four years

News and Views

Letters to the Editor

An explanation is due to our readers for the unusually large proportion of this week's issue of Nature devoted to Letters to the Editor In Nature of February 10 we published an enlarged paper to provide accommodation for twenty columns of correspondence since then we have printed a dozen or so letters each week which have occupied altogether a hundred columns of space In fairness to our correspondents it should be said that many of them have acted upon our suggestion that communications should be reduced in length but still it has been difficult to ensure that prompt publication of current work which is now so widely recognised as one of the chief functions of our correspondence columns In the circumstances it has been decided once more to publish an extra number of pages of correspondence in order to reduce the waiting list and the present issue of Nature therefore contains thirty two columns under the heading Letters to the Editor Of the twenty nine communications printed about a half are from centres in Great Britain and Ireland The remainder come from places so wide spread as Copenhagen Leningrad Moscow and Warsaw in Europe Boulder Chicago Harvard and Montreal in North America Sendai in Japan Cairo and Kyancutta (South Australia) They provide further evidence if such be needed of the wide circulation of this journal and the keen activity with which scientific problems are being attacked in many parts of the world

Prof G H Lemaître

Prof G H Lemaître professor of mathematical methodology and the history of mathematical sciences in the University of Louvain has been awarded the Francqui Prize of the value of 500 000 francs The Francqui Foundation was created in 1932 and may award this annual prize to the Belgian who has made outstanding contributions to science and thus enhanced the international prestige of Belgium. This year's prize has been awarded to Prof. Lemaître for his outstanding work on the systems of galaxies and on cosmic theory. His discoveries and theories have had a profound influence on astrophysical and physical thought throughout the world, especially in connexion with the theory of the expanding universe which he originated. The presentation was made in the presence of the King of the Belgians.

Native Problems in North Australia

THE natives of Arnhem Land in North Australia are presenting an interesting problem to the Commonwealth Government. The methods usually adopted in dealing with disturbances among the natives are the old time punitive police expedition or special missionary enterprise; quite recently a mixture of the two has been tried. As Prof. F. Wood Jones has pointed out, the former is apt to lead merely to massacre and the latter must be admitted to have failed to effect any permanent solution of the problem. It is properly soluble only by rigorous segregation of the blacks from settlers, traders and the like (European and Asiatic), and by prolonged intimate study of them by highly trained anthropologists willing and able to live amongst them as members of their tribes. The University of Melbourne has made an admirable and practical move in offering to the Department of the Interior the services of an able and experienced research student to work amongst the Arnhem Land natives. To the great regret of all who are interested in these primitive peoples, the offer has been declined, but the last has not been heard of it. On scientific no less than humanitarian grounds a determined effort along sound modern lines should be made to resolve this long neglected native problem. The establishment of a Commonwealth Department of Native Affairs would be a step in the right direction.

Water Supplies in Great Britain

IN reply to a question in the House of Commons on April 9 as to the present position in regard to water supplies in Great Britain, Mr. Ramsay MacDonald said: "The reserves of many water undertakers have fallen to a low level for this time of the year. The Government have been carefully watching the situation and, because of the continued absence of abundant rains, are satisfied that emergency measures must be taken. Therefore, in view of seriousness of the position, the Government propose to bring legislation before the House immediately." The Water Supplies (Exceptional Shortage Orders) Bill was accordingly presented to the House on April 10, whereby the Minister of Health, and the Secretary of State and the Department of Health for Scotland, would be authorised "to make orders, and to give directions with a view to meeting deficiencies in water supplies due to exceptional shortage of rain, and for purposes connected with the matters aforesaid". It will be remembered that the subject of water supply and regulation was discussed in NATURE of November 11, 1933, p. 725, in an article dealing with a report of a committee of the British Association when the institution of an inland water survey of Britain was urged as a necessary preliminary to efficient water administration. Reference was also made in that article to the presidential address to the Institution of Mechanical Engineers delivered by Mr. Alan Chorlton, M.P., in which he suggested the construction of a water grid in Great Britain comparable with the electricity grid recently completed.

Pooling of Water Supplies

MR. CHORLTON returned to the subject in a recent paper read before the Royal Society of Arts (*J. Roy. Soc. Arts*, Feb. 23, 1934), in which he directs attention to the policy of Great Britain which has allowed water supply to remain in the hands of local authorities without any national plan devised in the interests of the population as a whole. As a result there are 1,100 separate water undertakings in the country with a mosaic of disconnected entities and interlocking boundaries. Urban areas are best served, but many rural areas require adequate provision. A hydrogeological survey is needed before plans on a large scale can be matured. Furthermore, some pooling of supplies is essential because of the vagaries of rainfall within any given year, and lastly, special storage reservoirs should be constructed to serve abnormal demands in dry seasons. These might be in the Thames valley for the south generally, in south Lincolnshire for the Ouse flood waters, and in the Lake District to serve the industrial areas of Lancashire. Such undertakings would, according to Mr. Chorlton, have many advantages in providing a certainty of good water in all areas and a possibility of encouraging increased use of water without alarm of shortage, while the expenditure on labour would decrease unemployment for some years to come.

Australian Support for Empire Agricultural Research

SATISFACTION will be felt at the decision of the Commonwealth Government to adopt the recommendation of the Executive Council of the Imperial Agricultural Bureaux that financial support be given to certain research organisations in Great Britain formerly assisted in part by the Empire Marketing Board. It is true that the sum involved is not very considerable—£800 per annum to the Entomological Laboratory at Farnham Royal, £500 to the Station at Slough dealing with insect infestation of stored products, and £4,500 to the Low Temperature Research Station at Cambridge—a total of £5,800 per annum. The point of importance, however, is that the Australian decision is an indication of the growing feeling there that teamwork in agricultural research is not merely desirable in the interests of the various members of the Empire, but also is essential if full advantage is to be taken of the limited total resources available for scientific work. The Empire Marketing Board did much to foster this spirit, the value of which is clearly recognised in the outlying dominions

Rothamsted Experimental Station

THE recent appeal for £30,000 for the purchase of the Rothamsted experimental fields has met with a ready response and already £22,000 has been promised This is due chiefly to the generosity of Mr Robert McDougall of Cheadle, who has offered £15,000, and the Sir Halley Stewart Trust, which has offered £5,000, on condition that the remaining £10,000 be secured by May 12, when the option on the land expires Towards this, £1,000 has already been given by Sir Bernard Greenwell, and another £1,000 by other donors Strenuous efforts are now being made to obtain the remaining £8,000 and all friends of Rothamsted are invited to send subscriptions to the Director, Rothamsted Experimental Station, Harpenden Barclays Bank and the National Provincial Bank have kindly posted the appeal in their rural branches and the National Farmers' Union is asking its branches to help But the countryside though sympathetic and appreciative, is not well off, and for much of the £8,000 the Station will have to depend on the generous help of public spirited men and women who, while recognising the importance of agriculture to the community, are not themselves actually farming It would be indeed a tragedy if Rothamsted should, after all, lose these fields now that success seems so nearly within reach

Short Wave Radio Echoes

IT is now well known that all long distance radio communication takes place by means of electric waves reflected from one of the ionised regions of the atmosphere, the time of travel of the waves from the emitting station up to the reflecting layer and back to the earth being usually a small fraction of a second Some six years ago a Norwegian engineer, G Hals, discovered the existence at certain times on short wave lengths of wireless echoes received as long as three seconds after the cessation of the original signals (see NATURE, 122, 681, Nov 3, 1928) These observations were afterwards confirmed by Prof C Størmer, and specially organised experiments by experts in different countries showed that echoes of up to 25 or 30 seconds' delay could be detected, although they were of rather rare and uncertain occurrence

To explain the existence of such echoes, Prof Størmer put forward the suggestion that the emitted waves had penetrated the ionosphere and were reflected from a belt of electrified corpuscles ejected by the sun and formed into a vast toroid by the influence of the earth's magnetic field If the waves travelled with their normal velocity, this toroid would have to be situated at a distance of several hundred thousand miles from the earth Other investigators, however, pointed out that the variation of the group velocity of the waves in the ionosphere might be an important consideration in defining the actual path of the waves In order to obtain more experimental data on this subject, Prof E V Appleton, of King's College, London, who is well known for his investigations of the ionosphere, has suggested that observations should be carried out by a large body of amateur listeners equipped with suitable short wave receivers The formation of an organisation suitable for this and other similar investigations is described in *World Radio* of April 6 by Mr Ralph Stranger, of the technical staff of that journal It is proposed that a number of powerful transmitting stations in Great Britain and other countries should emit at certain times strong characteristic signals, which will be the subject of observation throughout the world The results obtained will be collected and carefully analysed The conclusions reached from the conduct of this large scale experiment will be awaited with interest

Centenary of the Royal Statistical Society

THE ROYAL STATISTICAL SOCIETY had its birth at a meeting held in London on March 15, 1834, under the chairmanship of the Marquis of Lansdowne, and the centenary will be celebrated on April 17, when the Prince of Wales, an honorary president of the Society, will preside at a meeting to be held at University College, London The Society arose out of the Cambridge meeting in 1833 of the British Association During the meeting which was attended by the famous Belgian mathematician, Quételet, a small gathering of members interested in statistics was held in Trinity College Through this, Babbage was led to suggest the formation of a statistical section of the Association His suggestion was approved and a committee appointed It was, however, soon recognised that for the collection of materials a more permanent society would be required, and this led to the meeting of March 15, 1834, when it was resolved to establish a Statistical Society of London (see NATURE, March 10, p 389) The Society was incorporated in 1887, and is now in a flourishing condition One of the original recommendations was that it should of course be one prominent object of the Society to form a complete Statistical Library as rapidly as its funds may admit ' The Society has now a library of more than sixty thousand volumes

Local Government Officers

IMPORTANT recommendations regarding the qualifications, recruitment, training and promotion of local government officers are made in the recent report of a departmental committee under the chairmanship of Sir Henry Hadow to the Ministry of Health (London H M Stationery Office 1*s* 6*d* net) The Committee considers that considerable revision of the present system of recruiting and training officers is necessary, and makes the principal recommendation that a permanent central advisory committee should be appointed, representative of local authorities, to investigate and advise in all questions affecting local government service The co operation of such a central body is necessary to give effect to the Committee's proposals with regard to entry to the service by competitive examinations, the recruitment of an increased number of university graduates, on which special stress is laid, and the investigation of conditions of training, particularly with respect to the establishment of an administrative examination of appropriate standard for passing from the general grade of clerical officers to the higher grades

OTHER recommendations relate to the adoption of uniform grading systems and salary scales, the wide notification of vacancies, the establishment of a minimum age limit of sixteen years, coupled with the possession of a school certificate for entry to the service A certain proportion of junior clerical officers should be recruited at eighteen or nineteen years of age, apart from the systematic recruitment of university graduates and of professional and technical officers from all available sources A thorough investigation of technical qualifications is required, and coupled with greater precautions against personal influence in making appointments, greater mobility of officers between local authorities, the assignment by each local authority to one establishment committee of all questions affecting the recruitment, qualification, training and promotion of officers, these suggestions should assist in the development of a local government service able to meet the increasingly onerous demands made upon it

New Cheshire Nature Reserves

THE two Nature reserves in memory of the late T A Coward, the well known naturalist and author of The Birds of Cheshire" and The Vertebrate Fauna of Cheshire", of the Manchester Museum, who died on January 29, 1933, have been completed in Cheshire They have been formed by a committee of naturalists and admirers, the T A Coward Memorial Fund, under the chairmanship of the Right Hon the Earl of Stamford, though as yet some £200 of the purchase money is required It is proposed to hand the reserves over to the care of some national body like the National Trust The two sites chosen were Marbury Mere in mid Cheshire, and Cotterrill's Clough, a hanging' wood on the banks of the River Bollin within sight of Coward's home at Bowdon (NATURE, 132, 437, Sept 16, 1933) Each locality is rich in bird life At the latter, Coward recorded the grasshopper warbler, and used it for the recording of the arrival of migrant species, while the former, which includes a large lake and 1½ acres of woodland, and large reed beds which bring the extent up to 8 acres, is where the black tern, bittern, night heron, whooper swan, Bewick's swan, and great crested grebe have been recorded Some recent Marbury records include the white wagtail, a drake and two duck wigeon in July, scaup duck, goosander, cormorant, great northern diver, and ringed plover (Nineteenth Annual Report, Lancashire and Cheshire Fauna Committee) The honorary secretary of the Coward Memorial Fund is Mr J F. Hodkinson, 50 Selby Street, Manchester, 11

Roman Scotland

SIR GEORGE MACDONALD's reconstruction of the history of the Roman wall from Forth to Clyde, and of the strategic position in Roman Scotland in the second century A D from the evidence of his excavations, which appeared in the *Times* of April 7, justifies his citation of the dictum of the late Prof Haverfield that the spade would prove mightier than the pen, but at the same time will suggest to his readers the qualification that its superiority depends upon the skill of the excavator, and his constructive powers in the interpretation of his finds Sir George's ability in this respect enables him to piece together the data he has obtained from the thirty seven miles of wall between Bridgeness on the Forth to Old Kilpatrick on the Clyde, with its forts, ditch and flanking road for supply purposes, and to supply from it a conclusive solution for the more puzzling problems of a political and military situation which required the building of the forward line of defence and yet at the same time did not relieve the garrison of Hadrian's wall to the south The key to the situation, which he now supplies, is the vulnerability of the intra mural area from the inroads of the Dalriada Scots of Ireland through Galloway Further, he suggests, the country north of York being occupied in a military sense only, even though the outer wall provided an efficient barrier against attack by the northern tribes, it was necessary to have a garrison on the southern wall to shut off the partially subdued tribes on the southern side of the wall from those in the occupied Scottish area, in order to prevent any junction of disaffected tribesmen Sir George's suggestion that shortage of man power and a miscalculation of the pressure which could be brought to bear by Irish inroads is a logical, but none the less brilliant, reading of the situation when about 185 A D the outer line of defence was abandoned

An Expedition to Hainan

ALTHOUGH the flowering plants of Hainan have been extensively collected by Prof Woon Young Chun and his associates of the Botanical Institute, National Sun Yatsen University, Canton, the animals of the island, although previously collected by a few naturalists, are still incompletely known to the scientific world The Fan Memorial Institute of Biology, the Biological Laboratory of the Science Society of China, the Metropolitan Museum of Natural History of the Academia Sinica, the National Tsing Hua University, the National University of Peking, the National Shantung University and Nankai University have recently organised a joint expedition to Hainan The purpose of this is to collect zoological specimens as extensively as possible Cryptogams, orchids and wood samples will also be collected The Fan Memorial Institute of Biology will be represented by C Ho, entomologist, and S K Tang, taxidermist, the Biological Laboratory of the Science Society of China by Dr C C Wang, invertebrate zoologist, and Mr K F Wang, ichthyologist, the Metropolitan Museum of Natural History by Dr. H W Wu, ichthyologist, the National Shantung University by Mr C L Tso, botanist, and Mr Chungin H Liu, anthropologist, and Nankai University by Dr T S Hsiung, invertebrate zoologist Mr. C L Tso, who has had previous experience in the island and is familiar with the natives, will lead the expedition The members of the expedition were to leave Shanghai about January 15. One party is going to the famous Wu tchi shan or Five Fingers Mountain As the mountain attains the height of more than 2 000 metres zoological specimens, especially land vertebrates will be thoroughly collected in order to study the problem of vertical distribution Another party will make a coastal survey and pay more attention to the sea fauna

Research and Industry in New Zealand

NEW ZEALAND's position in relation to world commerce was reviewed by the Governor General Lord Bledisloe on September 29 in an address to the Canterbury Chamber of Commerce at Christchurch In the course of the address he referred to the resentment often expressed in regard to excessive mechanisation and other social and economic ills entailed by the progress of scientific research and the application to industrial processes of the resulting discoveries The remedy is to be sought he suggested not in arresting the march of science especially in a country which has so much to gain from agricultural and other scientific research but rather in redoubling research in those fields of economics psychology sociology and education in which are to be sought solutions of those problems which have hitherto baffled mankind of the distribution of the wealth which the applications of other branches of science have already made abundantly accessible From the enunciation of this doctrine of the social centrality of present day science he passed on to consider the limits within and conditions on which State guidance and organisation are likely to produce better results than unshackled individual enterprise

'Discovery' Report on Foraminifera of South Georgia

A CORRESPONDENT Mr M E Challen has directed our attention to the fact that in Mr A Earland's report on the Foraminifera of South Georgia (Discovery Reports 7 27 138 1933) a new species (No 158) *Bigenerina minutissima* is recorded from two stations WS 199 WS 472 not included in the chart Mr Earland informs us that the species in question was not found in the South Georgia area and that its inclusion was an error observed too late for correction in proof The two stations WS 199 WS 472 are in the deep water of the Scotia Sea within the area covered by his forthcoming report on Antarctic Foraminifera References to them have also crept into the South Georgia report under *Ammobaculites agglutinans* (No 116) *Ammomarginulina ensis* (No 122) and *Clavulina communis* (No 165) but are of less importance as these species were found elsewhere in the South Georgia area Protozoologists may be glad to rectify these errors in their copies of the report

Prof S H Vines, F R S

OUR Oxford correspondent writes The tenure of the Sherardian professorship of botany by the late Sydney Howard Vines F R S which lasted from 1888 until 1919 was marked by a notable development in the activity and usefulness of the botanical department of the University The studies of this department associated in former years with the names of Morison Sherard Dillenius Sibthorp and Daubeny to which a quickening stimulus had already been applied by the vigorous personality of Sir Isaac Bayley Balfour were by Prof Vines advanced to a high degree of efficiency and the results of the energy which he brought to bear on the duties of his office are still apparent in the flourishing condition of the department of which Prof A G Tansley F R S is the present head The memory of Vines will live in Oxford as that of one whose outstanding ability and social charm made a deep and enduring impression on all his contemporaries

Aberdeen Public Library

ARRANGEMENTS in connexion with the meetings of the British Association in Aberdeen in September are in an advanced state It happens that the jubilee of Aberdeen Public Library—established 1884—occurs this year and the Library Committee proposed to celebrate the anniversary by offering the hospitality of the Library to representative members of the British Association, mainly in the form of an evening reception in the Central Library It happens however that no evening is available in the Association's programme Accordingly the celebration is to take the form of a luncheon in the Reference Department of the Central Library on Friday September 7

New Committee for Research in Mental Disorders

THE Medical Research Council in consultation with the Board of Control has appointed a new committee to advise and assist in the promotion of research into mental disorders The reconstituted committee will include representatives not only of psychiatry medical psychology and the study of mental deficiency but also of neurology physiology biochemistry pathology and genetics The chairman of the Committee will be Prof E D Adrian of the Medical Research Council and the following will also serve Sir C Hubert Bond Board of Control Dr Bernard Hart University College Hospital London Prof D K Henderson Royal Edinburgh Hospital for Mental and Nervous Disorders Dr T A Ross Cassel Hospital Penshurst Dr E O Lewis Board of Control Dr C P Symonds Guy's Hospital London Dr J H Quastel Cardiff City Mental Hospital Dr J G Greenfield National Hospital for Nervous Diseases London F L Golla Maudsley Hospital London, and Dr L S Penrose Royal Eastern Counties Institution Colchester Sir David Munro of the Council's staff will act as secretary

Research Conference on Spectroscopy and its Applications

ON account of the enthusiastic response to the Spectroscopy Conference held at the Massachusetts Institute of Technology last summer which was attended by more than a hundred workers from America and abroad it has been decided by the Institute to hold a second conference this year A programme of papers and discussions is being prepared on the following topics among others absorption spectrophotometry (application to analysis of *organic and inorganic substances and to the diagnosis* and treatment of disease) analysis by the emission spectrum (determination of metallic and other atomic and molecular constituents of samples) biological and chemical effects of spectral radiation spectroscopy of the ultra violet and infra red analysis of spectra and measurement of wave length It is anticipated that the earlier sessions of the week will be of especial interest to biologists medical research workers and chemists The main emphasis will then shift to subjects of chief interest to the industrialist and engineer the geologist and the metallurgist The latter part of the week will be devoted to more theoretical problems of the spectroscopist The meetings will be open to anyone interested in the topics under discussion The Massachusetts Institute also announces a special programme of summer courses on spectroscopy and its applications to be given during the six weeks preceding the conference which will deal primarily with applications of spectroscopy to biology chemistry geology metallurgy and mineralogy Inquiries regarding the Conference and courses should be addressed to Prof G R Harrison Department of Physics Massachusetts Institute of Technology Cambridge Massachusetts

Announcements

THE Garton Prize of £500 and Gold Medal of the British Empire Cancer Campaign offered this year for an essay on The Biological Effects and Mode of Action of Radiations upon Malignant and other Cells has been awarded to Dr H A Colwell of Middlesex Hospital London As one of the other essays was of high merit the Grand Council of the Campaign has decided that a second award of £100 should be made to its authors Dr F G Spear in association with Dr R G Canti Mr I G Grimmett Dr B Holmes Miss S F Cox and Dr W H Love

THE HON OLIVER STANLEY M P Minister of Transport will unveil a tablet erected at University College London by the executive committee of the Trevithick Centenary Commemoration on April 23 The tablet commemorates Trevithick s locomotive experiments in 1808

PROF E K RIDEAL professor of colloid science in the University of Cambridge will deliver the twenty fourth annual May Lecture of the Institute of Metals on May 9 at the house of the Institution of Mechanical Engineers taking as his subject Gases and Metal Surfaces

THE Annual Congress of the South Eastern Union of Scientific Societies will be held at the University of Reading on July 11–14 Further information can be obtained from the Hon General Secretary, Mr Edward A Martin 14 High View Close Norwood London S E 19

A TOUR of Norway (Oslo and Bergen areas) has been arranged by the Geologists Association to take place on August 2 14 Further information can be *obtained from the Secretary Mr W L Turner* 18 Valley Road Shortlands Bromley Kent

PROF F A F Crew director of the Institute of Animal Genetics University of Edinburgh has received the following telegram from Prof N I Vavilov All Union Soviet Conference at the Academy of Science Leningrad on the Evolution of Domestic Animals express greatest regret on the death of Professor Cossar Ewart pioneer of investigations on the origin of domestic animals President of Conference Vavilov

A COURSE of lectures on Pathological Research *in its Relation to Medicine* will be *given in* the lecture theatre of the Bacteriological Department of the Institute of Pathology and Research St Mary s Hospital London W 2 on Thursdays at 5 p m commencing on April 12 Sir Almroth Wright principal of the Institute is giving the opening lecture The other lecturers will be Prof A Bethe H W Bell Cairns Sir Bernard Spilsbury Prof J B S Haldane Prof J C Drummond Prof E N da C Andrade Dr Leonard Colebrook

A COURSE of two lectures delivered by Dr A N Whitehead before the University of Chicago last October will be published shortly by the Cambridge University Press under the title Nature and Life The book is an attempt in brief to unite the world of science with the worlds of religion art literature and morality and to show that Nature itself has processes goals beauty and values

APPLICATIONS are invited for the following appointments on or before the dates mentioned —A head of the Textile Department at the Municipal Technical College Halifax—The Principal (April 20) A chemist for the Aeronautical Inspection Directorate Air Ministry Test House Kidbrooke S E —The Secretary S 2 Air Ministry Kingsway W C 2 (April 21) Two economists for the Ministry of Agriculture and Fisheries The Secretary Ministry of Agriculture and Fisheries 10 Whitehall Place London S W 1 (April 23) An assistant lecturer in chemistry (subsidiary botany or pharmacognosy or pharmacy) at the Belfast Municipal College of Technology—The Principal (April 24) Two chemists (Class II) *male* in the Department of War Department Chemist—The Under Secretary of State The War Office (C 5) London S W 1 (April 28) An assistant lecturer in geography at the University of Manchester—The Registrar (April 30) Examiners in anatomy and physiology for the fellowship and in biology anatomy, physiology etc for the Conjoint Board at the Royal College of Surgeons of England—The Secretary (May 1) An assistant lecturer in dietetics and physiology at the King s College of Household and Social Science Campden Hill Road London W 8—The Secretary (May 5)

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of rejected manuscripts intended for this or any other part of Nature *No notice is taken of anonymous communications]*

Disintegration of the Diplon

It has been shown by Oliphant Harteck and Lord Rutherford in a recent letter[1] that the bombardment by high velocity diplons of compounds containing diplogen gives rise to three groups of particles two groups of equal numbers of singly charged particles of ranges 14 3 cm and 1 6 cm together with neutrons of maximum energy of about three million volts They suggest as possible explanations of these results the reactions

$$ _1D^2 + {}_1D^2 \rightarrow {}_1H^1 + {}_1H^3 \qquad (1)$$
$$\text{and } {}_1D^2 + {}_1D^2 \rightarrow {}_2He^3 + {}_0n^1 \qquad (2)$$

an atom of $_1H^3$ of 1 6 cm range and a proton of 14 3 cm range satisfying the momentum relations in reaction (1) In this reaction it is to be expected that the proton and the isotope of hydrogen of mass 3 would recoil in opposite directions except for a small correction due to the momentum of the captured diplon The cloud track method is extremely suitable for an examination of this possibility and I have recently taken expansion chamber photographs of the disintegration particles resulting from the bombardment of a target of heavy ammonium sulphate with diplons, to see if further information can be obtained

Fig 1

The first set of experiments was made with a thin target contained in an evacuated tube at the centre of the chamber Two opposite sides of the end of this tube were closed with mica windows of 6 3 mm and 11 4 cm stopping power respectively The chamber was filled with a suitable mixture of helium and air to increase the lengths of the tracks of the short particles Under these conditions, the particles of 14 3 cm range emerging through the thick window and the particles of 1 6 cm range emerging through the thin window end in the chamber and the usual re projection permits precise determination as to whether the two tracks are co planar and of the ranges Owing to the fine structure of the grid supporting the thin window the efficiency of collection of pairs cannot be high, also the companion to a 14 3 cm particle passing through the thin window would not be able to pass through the opposite thick window In spite of these difficulties opposite pairs of tracks of about 14 3 cm and 1 6 cm range are observed with far greater frequency than could be attributed to chance The photograph reproduced as Fig 1 is a fortunate example the short track on the right being due to the new hydrogen isotope of mass 3 Detailed measurements of the lengths of the tracks and the angles between them are being made and will be published later

To investigate the neutron emission a second series of experiments has been made in which a target of the same material contained in a lead tube of 3 mm wall thickness was bombarded in the same manner, the chamber being filled with a mixture of 50 per cent helium in air Under these conditions, thirty one recoil tracks originating in the gas have been photographed Assuming that these are due to impacts with neutrons the latter appear to constitute an approximately homogeneous group of maximum energy of about 1 8 million volts This energy appears to be in fair agreement with reaction (2) on substitution of the mass of $_2He^3$, which can be estimated from consideration of the energies of the short range products resulting from the transformation of $_3Li^6$ by protons[2,3,4] The $_2He^3$ group of reaction (2) with a possible range of about 5 mm would not pass through the thinnest window used in these experiments but special arrangements are being made to search for them in an expansion chamber

These experiments are the first to be made with a new discharge tube constructed following a design due to Dr Oliphant I should like to acknowledge the much valuable advice which Dr Oliphant has always so readily given me in the course of construction of this tube I am also indebted to him for preparing the diplogen targets used in these experiments

P I Dee

Cavendish Laboratory,
Cambridge

[1] Nature 133, 413, March 17 1934
[2] *Proc Roy Soc*, A, 141 722, 1933
[3] Nature 132 818, Nov 25 1933
[4] Nature 133 377 March 10 1934

An Artificial Radioelement from Nitrogen

Messrs M Danysz and M Zyw, working in this laboratory, have bombarded diverse substances with α rays from a thin walled glass tube (resulting range about 5 cm) containing some 15 millicuries of radon, and immediately afterwards have tested their activity with a Geiger Müller counter An activity decaying exponentially with a half period of 1 2 min was found on *all* the substances examined, namely, platinum, silver, lead, calcium and nickel No certain influence of the nature of the substance could be ascertained The initial activity was of the order of 50 impulses per minute The effect disappeared when the range of α rays was reduced by two very thin gold foils or a few millimetres of air

In subsequent experiments, a strongly activated platinum wire was used as source In order to avoid contamination, the wire was enclosed in an airtight box, covered with a film of less than 1 mm stopping power The effective range of α rays from radium C′ was 6 5 cm The effect was greatly increased and amounted to about 200 impulses per minute with a source equivalent to 8 mgm radium

An obvious explanation of the effect was that it was due to the recoil of some new radio element produced by the very fast α particles (Incidentally, it has been found that the recoil of radiophosphorus is easily detectable) To test this possibility experiments have been made (*a*) *in vacuo* (*b*) in hydrogen (*c*) in nitrogen (*d*) in oxygen As the effect was apparent *only in nitrogen* we conclude that it consists in a transmutation of nitrogen[1] of the Joliot type, the probable reactions being

$$(1)\ {}_7N^{14} + {}_2\alpha^4 = {}_9F^{17} + \text{neutron} \quad (2)\ {}_9F^{17} = {}_8O^{17} + \text{positron}$$

An examination of the particles entering the counter showed that they are completely absorbed by some 0 5 gm /cm ^{2} of lead An experiment with a magnetic field has shown definitely that the particles are positrons

It appears probable that the transmutation of the Joliot type may be found in all known cases of transmutation of elements involving the emission of protons

L WERTENSTEIN

Mirosław Kernbaum
Radiological Laboratory
Warsaw
March 17

Note added to proof We have since found that NaN_3 gives a greatly increased effect which confirms our assumptions

New Source of Positive Electrons

OBSERVATIONS made with a weak radium source placed inside the Wilson chamber in a magnetic field showed that in addition to the β particles of the natural spectrum a very considerable number of positive electrons are also emitted

The radiator consisted of a thin layer of radium salt deposited on the inner surface of a thin walled glass tube This small tube was introduced into a cylindrical protecting tube (of lead in our first experiments and afterwards of carbon) in the wall of which (4 mm thick) a 2 mm opening had been made By this means an almost point like source of β rays was obtained the velocities of which could be measured in the usual way Under favourable conditions tracks of positive electrons could be observed once in every three to four expansions on the average Up to the present 30 tracks have been observed with the following distribution of velocities

Energy intervals (e /kv)	Number of positrons
100–300	8
300–600	16
600–900	6

The number of positrons corresponding to every disintegration can be determined directly by calculating the number of electrons belonging to the natural spectrum, the tracks of which are seen on the same photographs We have calculated the number of β rays with an energy exceeding 1 000 kv , the total number of disintegration electrons was determined according to the well known distribution curve of the continuous spectrum The data obtained clearly show that the number of the emitted positrons are not less than 0 02–0 04 for each disintegrating atom of radium C This unexpectedly high number exceeds by several times the total number of photo electrons in the natural spectrum of radium C (According to Ellis[1] the number of electrons per disintegration of all groups of the linear spectrum of radium C is about 0 009) This comparison makes it highly improbable that the observed positive electrons are due to the internal conversion of γ rays In any event the coefficient of internal conversion which would have to be adopted on the assumption that the observed phenomenon is due to the internal photoeffect from the levels of negative energy exceeds the theoretical value *some hundred times*

The theoretical data available are not sufficient for a comparison to be made A rough estimate can be obtained by assuming the upper limit of the effect which would be still compatible with theoretical considerations to have the following value

Nedelsky and Oppenheimer[2] give for the wave length $\lambda \to 4\ 7$ X U the internal conversion coefficient 5×10^{-4} If we assume that all the γ lines in the spectrum of radium C with $h\nu > 1120$ kv (the number of quanta per disintegration 0 45) undergo internal conversion with the coefficient 5×10^{-4} calculated for the limit of the spectrum, then the number of positive photoelectrons will be equal to $0\ 45 \times 5 \times 10^{-4}$ 2×10^{-4} Thus some new mechanism appears to be involved in the production of positrons being presumably connected with β disintegration

It may be added that Lecoin[3] using the same method of investigation was unable to observe the emission of positive electrons in the case of radium E, where the limit of the spectrum does not very much exceed 2 mc^2 Neither can the observed phenomenon be ascribed to the effect of α particles which has recently been discovered by Curie and Joliot[4] since this would mean one positron corresponding on the average to every 100 α particles

Note added in proof (March 17) More recent experiments have shown that a considerable part of the positrons must be due to the action of the β rays on the walls surrounding the radioactive source A further communication follows

D SKOBELTZYN
E STEPANOWA

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Feb 12

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[1] C D Ellis *Proc Roy Soc* A 143 350 1934
[2] L Nedelsky and J R Oppenheimer *Phys Rev* 44 948 1933,
[3] M Lecoin *C R*, 197 405 1933
[4] I Curie and F Joliot *C R* 198 254 1934

Decay Constant of Radium C

IN previous notes[1] an account has been given of a measurement of the decay constant of radium C The method consisted in determinations of the number of α particles emitted from a beam of recoil atoms from radium C at various distances from the source For the half period a value of the order 10^{-8} sec was found During a continuation of these experiments it was found that the number of α particles emitted from a beam of recoil atoms depended greatly on the temperature of the walls of the apparatus When the walls were cooled by liquid air the source being at room temperature, a large number of α particles were emitted from the wall facing the source From these experiments it was concluded that at room temperature the recoil atoms are at least partly reflected from the walls of the apparatus The dependence of the number of α particles emitted from the recoil atoms on the temperature of the walls indicated that the shape of the decay curve was complicated by the reflection of the recoil atoms from the walls

Since Gamow's theory gives a much greater value for the life period than that found in the experiments with moving recoil atoms, it was thought possible to obtain an estimate of the life period of radium C′ by means of Geiger counters without making use of the recoil phenomenon The arrangement which was finally adopted[2] consisted of two small counters, placed close to one another in a vessel, which was exhausted to a pressure of 5 cm of mercury The central electrodes were connected to the grid of each one of two amplifying valves, each of the anode circuits contained a *moving iron* oscillograph The active material (about 10^{-6} mgm) was placed between the counters By closing the counters by aluminium foils of appropriate thickness, it was arranged so that one of the counters was excited only by β particles, the other by both α and β particles

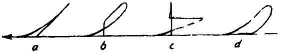

FIG 1

The deflections of the mirrors of the oscillographs were crossed, so that one mirror gave a horizontal deflection the other a vertical one Light from an arc lamp was reflected successively from the two mirrors and concentrated by a lens on a film, which was moved with a velocity of about 1 cm per second The appearance of the deflections obtained is shown in Fig 1 (*a*, *b*, *c*, *d*) The direction of movement of the light spot on the film is shown by the arrow, *a* shows a true coincidence, in *b* and *c* the counters are excited with a time difference shorter or longer respectively than the duration of the impulse from the counter, for this a value of 1 5 × 10^{-8} sec was obtained in separate experiments, a time difference of a tenth of this could still be detected In *d* the time difference has the opposite sign to that of *b* This type of deflection is not suited for measurements, since the position of the bend is difficult to observe

With radium C as source, a large number of deflections of the types shown in *a* and *b* (or *d*) were observed The sign of the time differences showed that the β particle was emitted before the α particle Deflections of the types *a* and *b* were obtained in about equal numbers, this gives for the half period of radium C a value of 2 × 10^{-4} sec with an accuracy of about 50 per cent A more accurate determination would require a knowledge of the frequency of occurrence of time differences of different lengths Such a procedure would scarcely be legitimate considering that the magnitudes of the impulses from the counters were varied somewhat

The existence of eventual time lags in the action of the counters was tested by using thorium C as source With this substance, only true coincidences were observed, this shows that the time lag in the action of the counters is small compared with 10^{-4} sec

J C JACOBSEN

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March 6

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[1] *Phil Mag* 47, 23, 1924 NATURE 120 874, Dec 17 1927
[2] NATURE 128, 185 Aug 1 1931

Continuous X-Ray Spectrum from a Thin Target

IN order to investigate the true energy distribution in the continuous X ray spectrum, the target to be used must be sufficiently thin to ensure that the cathode rays passing through it produce only a single excitation For ordinary voltages, metal foils 10^{-4}–10^{-5} cm thick can be used for this purpose The intensity of X rays obtained under these conditions is very low, a fact which prevented Kulenkampff[1] measuring the energy distribution with a crystal spectrometer

It was found possible to investigate the intensity distribution in the continuous spectrum from a thin aluminium foil with an ionisation spectrometer equipped with a Geiger Muller tube counter, instead of the ionisation chamber The aluminium foils used had an initial mean thickness of 5 5 × 10^{-5} cm, under the bombardment by cathode rays the thickness decreased to such an extent that the cathode spot became semi transparent, corresponding approximately to the thickness of 1 × 10^{-5} cm, all the measurements were performed with these thinned foils

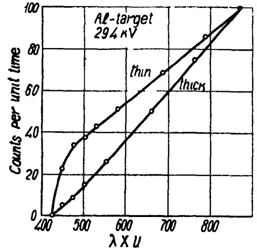

FIG 1

The ionisation spectrometer was set at an angle of 90° between the X rays and the cathode stream The rays were analysed by a calcite crystal, and entering the tube counter along its axis, did not strike the walls or the central wire The counter was filled with a mixture of argon at a pressure of 46 cm and air at 10 cm

Intensity distribution measurements in the wave length region from λ_0 to $2\lambda_0$ (λ_0 is the high frequency limit of the spectrum) from thin targets were made at voltages of 20, 30 and 40 kilovolts For comparison, analogous measurements were repeated with a thick aluminium plate The intensity curves directly obtained in both cases at 30 kv are shown in Fig 1 Similar results were obtained at the other voltages

The following points must be considered in order to deduce from these curves the true energy distribution (1) absorption of the rays on their path from the target to the counter, (2) incomplete absorption in the counter, (3) finite slit widths, (4) wave length dependence of the reflection coefficient of the crystal In the case of the thick target, the absorption in the target itself must be also taken into consideration

Applying the corresponding corrections and calculating from the number of quanta recorded by the counter the energy one can finally obtain the true energy distribution in the spectrum

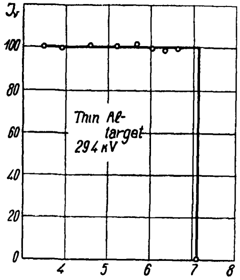

FIG 2

For thin targets the energy is found to be independent of the frequency from ν_0 to $\frac{1}{2}\nu_0$ At the high frequency limit ν_0 there is a sharp discontinuity (Fig 2) This result is in accord with Sommerfeld's[2] theory of the continuous spectrum For the thick target the well known energy distribution as represented by Kulenkampff's formula is obtained

W DUKELSKY

Physical Technical Institute
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Feb 9

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[1] H Kulenkampff *Ann Phys* 87 597 1928
[2] A Sommerfeld *Ann Phys* 11 257 1931

Vibrational States of Rb_2 and Cs_2

THE channelled bands of rubidium and cæsium have already been studied by many authors but the analyses of the vibrational states have not been completed By close examination of the spectrograms which I have obtained with a plane grating and a quartz lens of three metres in focal length I have found the vibrational structures of the bands and made an attempt to analyse them In the case of rubidium the frequencies of the heads of the bands may be represented as follows

For the red system

$$\nu = 14666 + 47\ 3(n + \tfrac{1}{2}) - 0\ 15(n + \tfrac{1}{2})^2 - 57\ 8(n'' + \tfrac{1}{2}) + 0\ 14(n'' + \tfrac{1}{2})^2$$

for the blue system,

$$\nu = 20930 + 38(n + \tfrac{1}{2}) - 0\ 3(n + \tfrac{1}{2})^2 - 57(n'' + \tfrac{1}{2}) + 0\ 1(n'' + \tfrac{1}{2})^2,$$

for the violet system,

$$\nu = 22968 + 38(n + \tfrac{1}{2}) - 0\ 0(n + \tfrac{1}{2})^2 - 59(n'' + \tfrac{1}{2}) + 0\ 1(n'' + \tfrac{1}{2})^2$$

In addition to these three systems another one at 8800 A was also observed with a spectrograph with a lower dispersion

It is generally accepted that the ground state of the molecules of other alkali metals is Σ_g^+ and there are two excited states Σ_u^+ and Π_u above this The system observed in the near infra red at 8800 A may be due to the transition $\Sigma_u^+ \leftarrow \Sigma_g^+$ and it is considered that the red one is due to the transition $\Pi_u \leftarrow \Sigma_g^+$ while the blue system may correspond to the blue band system in potassium

In the case of cæsium I have tried to arrange 83 heads of the red system at 6300 A which has already been measured by Rompe[1] but not analysed The formula is as follows

$$\nu \quad 15801 + 25\ 7n \quad 40\ 0n''$$

As a result of the lack of heads corresponding to the higher quantum numbers and the slowness of convergency the terms of the second order were omitted In the band system at 7600 A 38 heads were measured and were arranged as follows

$$\nu \quad 13040 + 33\ 7n \quad 41\ 3n''$$

The other band system at 7200 A was also photographed but the close crowding of the heads near the system origin makes it very difficult to measure the heads From the measurements of 16 heads in the region of longer wave lengths it was known that the vibrational quanta of the lower and the upper states were 39 cm^{-1} and 29 cm^{-1} respectively A new absorption band was observed in the infra red spreading from 8735 A to the farther infra red

In the case of cæsium four band systems were observed near the resonance doublet but there are only two systems in other alkali metals Probably at the upper level of the system at 8700 A and 7600 A the molecules will dissociate into a normal and an excited $^2P_{1/2}$ atom while at 8200 A and 7200 A they dissociate into a normal and a $^2P_{3/2}$ atom

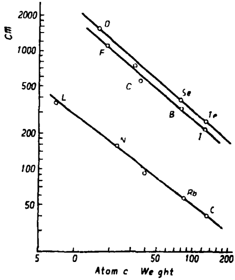

FIG 1

The strong absorptions at the shorter wave length end of the band observed in the cæsium, are due to the fact that on one branch of the Condon parabola the wave lengths of the heads are nearly constant

It is very interesting to remark here that the logarithms of the vibrational frequencies in the ground states of the molecules of five alkalis and of four halogens, together with four elements in the sixth group in the periodic table, vary linearly with the logarithms of their atomic weights, as shown in the accompanying figure (Fig 1) The points corresponding to K, Cl S were displaced downwards This anomaly appears also in the fifth group N, As, Bi lie on a straight line and P below the line

Full accounts of the experimental results will shortly be published elsewhere

E MATUYAMA

Physical Laboratory
Tôhoku University Sendai
Dec 25

[1] R Rompe *Z Phys* 74 175 1932

Stark Effect for the Hydrogen Isotopes

RECENTLY we have taken several photographs of the Stark effect in a mixture of the two hydrogen isotopes, using deuterium kindly supplied by Prof Urey The measured zero field separation of each pair of Balmer lines persists in high fields with small variations as noted below

The minimum field for good resolutions in the Stark effect is fortunately the same for nearly all the Stark components of each Balmer pair It varies, however, from about 50 kv /cm in $H_\delta^{1,2}$ to 130 kv /cm in $H_\alpha^{1,2}$

From left to right in the accompanying photograph (Fig 1) of $H_\gamma^{1,2}$ one finds alternately components of H_γ^2 and H_γ^1 The maximum field of 52 kv /cm is sufficient to show the character of the lines, and to separate completely the two Stark effects

The displacements are not exactly those given by the Epstein theory even when one allows for the second order effect The irregularities are made especially clear in the present analysis through variations in the separation of protium-deuterium pairs of Stark components At maximum field, the pair of moderate intensity immediately to the right of the centre of the σ image (Epstein $\Delta = 3$) have a separation 9 per cent higher than that of the corresponding pair on the left The contrast is even more pronounced in the π images From the evidence it appears improbable that these irregularities are constant for all field strengths According to measurements on $H_\gamma^{1,2}$, they are too large to attribute entirely to variations in the fine structure separations for the two isotopes

In moderately high fields, the central σ component of H_γ^2 appears to swing sharply to the red as though the second order effect were abnormally high This is found to be due to a superposed new molecular line which is clearly resolved through its large red shift in fields of 70 kv /cm Like most molecular lines on our plates, the new line has appreciable intensity only in rather high fields With a given mixture of isotopes, we find that at zero field the deuterium line is always stronger in $H_\gamma^{1,2}$ than in $H_\beta^{1,2}$ In the accompanying photograph, the light hydrogen line is clearly much the stronger in the normal spectrum With the application of even low fields, however, the energy passes more to H_γ^2, so that at maximum field the two patterns are of almost equal strength The intensity variations suggest as their principal origin collisions of the second kind between atoms of the two isotopes This phenomenon might be expected to become most prominent in cases of perfect resonance which exist at fields where components of the isotopes cross In the region between the strong central σ components, and at moderate fields it may be noticed that a component of H_γ^2 persists while the component of H_γ^1, which should cross at this point, is certainly weaker and appears to be lost On the above grounds, one may tentatively say that collisions of the second kind are more probable when the light atom is the one excited There may be however, a selective action whereby certain pairs of isotopic states are preferred in energy transfers , for the relative intensities of corresponding components of H_γ^2 and H_γ^1 are clearly not constant throughout the photograph, and in $H_\beta^{1,2}$ these fluctuations are more marked This amounts to the statement that there are departures from the Schrödinger intensities, and that the departures are not the same for the two isotopes

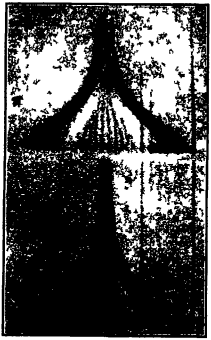

FIG 1 The spectral line $H_\gamma^{1,2}$ in fields up to 52 kv /cm

A great many new molecular lines are found with moderate displacements The research is being extended to include a study of the molecular spectra as well as the atomic spectra with varying proportions of the isotopes

Explosions occur in Lo Surdo sources when a small amount of oxygen is allowed to mix with the deuterium at a total pressure of one to two millimetres Under such conditions, explosions are not observed with light hydrogen In the present case they appear to be set off by a rather intense heating of the cathode surface

J S FOSTER
A H SNELL

Macdonald Physics Laboratory,
McGill University, Montreal
March 1

Absorption Spectra of Chlorophylls *a* and *b* at Room and Liquid Nitrogen Temperatures

THE absorption spectra of ether solutions of chlorophylls *a* and *b* prepared by the method described earlier[1] were photographed at the temperature of liquid nitrogen A Steinheil spectrograph and panchromatic plates were used for the spectral region λ 4100–6700 A Pyrex glass absorption cells with internal thickness of 1 mm contained the solutions Four plane quartz windows in the walls of the Dewar vessel permitted parallel light to pass from the Mazda source through the liquid nitrogen bath and the solid solution of chlorophyll in ether to the spectrograph slit The slit width was 0 02 mm The photographs were taken as soon as possible after freezing the solutions because the development of cracks in the solid ether solution caused it to become rather opaque in two hours

In the following table is a comparison of the absorption maxima measured at room temperature by a spectro photoelectric method[2] and those measured at 196 C by the photographic method The bands at room temperature are listed in order of their decreasing absolute intensities The band intensities at 196 C are listed in decreasing order as they appear on the plates

Wave-lengths of Absorption Maxima at

	25° C	− 196° C
Chlorophyll *a*	4275 A	End absorption to 4520 A
	6600	6640
	4100	4920
	6125	6320
	5725	6180
	5275	6015
	49 5	5760
		5365
Chlorophyll *b*	4525	4770
	4300	6510
	6425	4420
	5925	6000
	5675	6350
	5475	5760
	5025	5480

At − 196° C the absorption bands are considerably narrower than at room temperature and their maxima are shifted Absorption spectra of fraction *c* [1] at − 196° C were intermediate between those of components *a* and *b*

F PAUL ZSCHEILE JR
(National Research Fellow
in the Biological Sciences)

George Herbert Jones Chemical Laboratory
University Chicago
March 5

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[1] Zscheile F P Jr *Bot Gaz* to appear in June 1934
[2] Zscheile, F P Jr Hogness T R and Young T F *J Phys Chem.* 38, 1 1934

Investigation of Paraphysical Phenomena

A CERTAIN interest in the physical aspects of psychical research has recently been shown in these columns[1] In view of the fact that the controversy seems to turn mainly upon the alleged paranormal or extra-contemporary physical powers of Rudi Schneider, it may be worth while briefly to record a series of experiments with that medium, although the results are merely of a negative character Full experimental details will in due course be published in the *Proceedings of the Society for Psychical Research*

Sittings were held about twice a week from October 1933 until March 1934 inclusive in the *séance* room of that Society No evidence of absorptions of a beam of infra red light of the type recorded by Osty[2] and Herbert[3] could be obtained notwithstanding frequent announcements by the trance personality that the force had entered the ray The apparatus used was (1) a Moll galvanometer with Moll thermopiles and (2) a Westinghouse copper–copper oxide photoelectric cell in series with an Einthoven galvanometer In both cases the sensitivity and the precautions taken against electrical leaks, vibration and stray heating effects were such that an absorption of one half per cent could be detected All visible light was excluded from the beam by a sheet of ebonite of thickness of 0 005 cm or by a filter of 1 cm of a saturated solution of iodine in carbon disulphide in a glass vessel or by both For this solution Coblenz gives the following transmissions

Transmission	Per cent	Transmission	Per cent
0 75μ	0	3μ	60
1 0μ	80	4μ	10
1 2 5μ	90	5μ	0

This filter was used because the photographic work of Rayleigh[4] and Herbert indicated that absorptions did not occur at wave lengths shorter than 1μ while Herbert and Osty using photocells which cannot have been sensitive beyond 5–6μ both recorded absorptions The thermopiles should have been both sensitive and rapid enough to detect absorptions of the type previously recorded and the surface density of illumination was kept low as this is supposed[3] to increase the chance of observing absorptions The possibility of short period absorptions was negatived by the use of the photocell

A cinema camera was installed with a film sensitive to the infra red supplied by Messrs Ilford and it was found possible to obtain sharply defined moving pictures in a feeble red light By increasing the flood lighting and using horn or ebonite filters it is confidently expected that cinema films could be taken in total absence of visible light By this means, motion pictures of telekinetic phenomena could be obtained in a light that is innocuous to the medium No evidence however could be obtained of the telekinetic phenomena recorded by Price[5] and others, with the exception of a considerable number of movements not exceeding 10 cm of a hanging curtain In order to determine whether these were due to draughts a strip of tinfoil about a foot in length was so hung about 5 mm from a vertical metal plate that a slight draught brought them into contact and rang an electric bell The whole was so placed that the force had ready access to it and that draughts could not affect it Under these conditions the bell did not ring though the curtain continued to move

The force on several occasions was announced by the medium in trance to have gone into one of a pair of cotton wool lagged boxes and remained there for a period of some 15 minutes If any change in the difference of temperature between the two boxes was produced during this period a copper–constantan thermocouple showed that it was less than 0 003° C

During a period of half an hour the force could produce no significant difference in the rate of growth of two strains of *Bacillus fluorescens* or in the fermenting power of yeast

A comparative investigation of the medium s personalities normally and in trance was undertaken by means of the word association test in conjunction with the observation of the psychogalvanic reflex A preliminary scrutiny of the results shows that Olga', the trance personality has a vocabulary limited to the few words used by her during the ordinary sittings

It has been alleged that the trance personality is aware of what goes on in the dark *séance* room[5,6] in these sittings this was not found to be the case

The rate of breathing of the medium in trance ranged in these sittings from 90 to 260 cycles per minute continuing with two or three intervals of some 15 minutes each for 5 to 6½ hours The longest continuous period was 2½ hours with frequent stops totalling about 10 minutes In view of the fact that this respiration has been regarded as a remarkable physiological phenomenon samples were collected and analysed by Dr C G Douglas showing that the medium in no way overbreathes As the rate of respiration increases so its depth decreases the total oxygen consumption per minute observed never exceeded 1410 c c at N T P which corresponds to a man walking some four miles an hour During trance this medium is in constant often violent movement so that these results are in no way paranormal Moreover we have found no difficulty in imitating his breathing

Every suggestion made by the medium and the trance personality was acted upon and both repeatedly expressed their satisfaction with the arrangements and with the investigators On our side it is impossible to speak too highly of Rudi Schneider s willingness to submit to every suggested test and control, he acted throughout with the most scrupulous straightforwardness

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[1] NATURE 132 76, 801 849 1933
[2] E and M Osty Les pouvoirs inconnus de l esprit sur la matière 1932
[3] C V C Herbert, *Proc S P R* 41 259 1933
[4] Lord Rayleigh *Proc S P R* 41 89 269 1933
E Osty Supernormal Aspects of Energy and Matter (F W H Myers Memorial Lecture) pp 18 30 1933
[6] H Price Rudi Schneider 1930 An Account of some further Experiments with Rudi Schneider 1933

Transformation of Yellow Mercuric Iodide into the Red Form

RODWELL and Elder[1] have observed microscopically that when yellow orthorhombic crystals of mercuric iodide are touched the change into the red variety continues through the whole mass of crystals and the resulting pseudomorph consists of minute octahedrons of the red form

It is well known that the yellow form crystallises from a solution of mercuric iodide in alcohol and exists for varying lengths of time On viewing under the microscope single crystals free from etched markings the change from the yellow into the red variety is found to be in accordance with the usual type observed in solid reactions After about 15 minutes nucleation usually occurs along the whole length of the crystal edge the interface then advances rapidly across the crystal parallel to the opposite edge Occasionally nucleation occurs as a thin strip in the interior of the crystal parallel to the edges the interface then moves out towards the edges of the crystal with approximately the same linear rate in both directions It appears that nucleation occurs along some weak axis in the crystal and immediately spreads along the whole length, the reaction proceeds with the usual parallel advance At 20° C the mean linear rate of advance of the interface was 0 0025 cm /sec

By heating the red variety very much smaller rhombohedra of the yellow form were volatilised on to a cover glass Such crystals commenced to change into the red form after about five hours the reaction spreading inwards very slowly from all four edges with the usual parallel advance of the interface octahedra of the red form could be observed in the decomposed part of the crystal

The linear advance of the interface parallel to the edges of the crystal has previously been observed in the case of true decomposition for example potassium hydrogen oxalate hemihydrate[2] and potassium chlorate[3] and it appears to be characteristic also of the transition from one crystalline form into another of polymorphic substances

Investigation of the reaction is proceeding

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[1] Rodwell and Elder *Proc Roy Soc* 28 284 1879
[2] Hume and Colvin *Proc Roy Soc* A, 125 635 1929
[3] Coppock Colvin and Hume *Trans Far Soc* 27 283 1931

Rate of Nucleation of Copper Sulphate in Vacuum

THE rate of growth of the centres of dehydration of $CuSO_4 5H_2O$ varies with the crystal direction On the large faces of the crystal the nuclei grow in the form of a cross and the direction of the arms of the cross are parallel to two of the crystal axes The underlying surfaces of the nuclei prove to be very complex for a disc of dehydrated material is found to be suspended from the longer arm of the cross This disc passes into the crystal at an angle of approximately 33

Counts have been made of the rate of production of centres of decomposition on the surfaces of a crystal when this has been removed from the saturated solution carefully dried and placed in a high vacuum No visible nuclei appear at room temperature until after an induction period which is of the order of 100 minutes at 18° C Thereafter the number of nuclei increases at a linear rate The length of the induction period decreases with increasing temperature but on account of variations in the behaviour of individual crystals it has not been possible to determine the temperature coefficient Scratched crystals give shorter induction periods and crystals with irregular surfaces give larger numbers of centres than more perfect crystals

The induction period is most probably due to the slow rate of growth of the nuclei when first formed this rate being much slower than that of visible nuclei It is thus incorrect to assume in all cases of solid decomposition that the outward rate of growth of the nuclei is constant at all stages in their growth[1] In the decomposition of barium azide where the rate of decomposition is given by $dp/dt \sim t^{10}$ and in that of mercury fulminate where $dp/dt \sim t^{24}$, the observed induction periods are in the main to be ascribed to an accelerating rate of nuclear growth

N F H BRIGHT
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March 16

[1] Cf S V Ismailov *Phys Z Sowjet Union* 4 835 1934

Photochemistry and Absorption Spectrum of Acetone

IT has been generally assumed that the explanation of the diffuse absorption spectra of aldehydes and ketones in the ultra-violet is the occurrence of a process of predissociation involving the splitting of a C – H or C – C link[1]. Against this observation are the following observations:

(1) The vapours of aldehydes and ketones exhibit fluorescence.

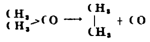
(2) The unimolecular decomposition is always accompanied by bimolecular polymerisation.

(3) The quantum efficiency of decomposition is diminished on passing from C – H to C – C compounds.

(4) Complex ketones decompose in quite a different way from acetone, giving very little carbon monoxide.

(5) The photodecomposition is not a chain reaction.

The photo-reactions of acetone illustrate (1) and (2). In the gaseous state it decomposes with a quantum efficiency of about 0·2 only[2], and we have found that in the liquid state it polymerises (without decomposition) with about the same quantum efficiency. As it is difficult to assume a back reaction to explain the low efficiency[3], it seems more probable that no splitting of a link occurs in the excited molecule. Instead, two processes may occur: (i) bimolecular interaction to give polymerisation; (ii) unimolecular decomposition through the similar interaction of two parts of the molecule, for example:



$$\begin{matrix}CH_3\\CH_3\end{matrix}\!>\!CO \longrightarrow \begin{matrix}CH_3\\|\\CH_3\end{matrix} + CO$$

In the case of the ketone $\begin{matrix}CH_3CH_2CH_2CH_2\\CH_3\end{matrix}\!>\!CO$ the products are not unexpectedly $\begin{matrix}CH_3 & CH\\ & \|\\ & CH_2\end{matrix}$ and $\begin{matrix}CH_3\\CH_3\end{matrix}\!>\!CO$[4].

Unless the above unimolecular dissociation takes place within a rotational period, it becomes necessary to find another explanation of the diffuseness of the absorption spectrum of some of these substances. We have recently examined the absorption spectrum of acetone, using pressures 0·5–200 mm in absorbing columns up to one metre. With pressures higher than a few mm a region of continuous absorption extends from c. 3200 A. to 2400 A., with a maximum at about 2800 A. This is the region characteristic of compounds containing the > C = O group. At lower pressures in longer columns and under higher dispersion (Hilger E_1 spectrograph) this continuum splits up into about four groups each containing about 25 diffuse bands. The centres of the respective groups lie at c. 3150, 2900, 2710 and 2570 A. The corresponding intervals are 2740, 2420 and 2010 cm^{-1}. (A strong Raman frequency of acetone is 2900 cm^{-1}.) The width of the bands is of the order 2·5 A. (c. 30 cm^{-1}) and their separation uniformly about 4 A. With increasing pressure the bands widen and the groups extend so as to produce an effectively continuous absorption.

This type of equally spaced diffuse narrow diffuse bands is similar to that found in other *Y*-shaped molecules[5]. Assuming that the CH_3 groups of acetone behave as single masses of 15, and using probable interatomic distances, the moments of inertia of the *Y*-shaped molecule are such that the rotation lines in the bands should be separated by only *c.* 0·4 cm^{-1}. There will, moreover, be a double series of *P* and *R* branches. It seems therefore inherently impossible to detect the fine structure in this spectrum, and the diffuseness of the bands can be attributed to an unresolved close packing of the rotation lines without calling upon the additional hypothesis of predissociation.

In the case of formaldehyde, where the moments of inertia are much smaller, it is not surprising that a region of fine structure is observed followed by diffuse bands, indicating unimolecular rearrangements within periods greater or less than those of rotation.

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H. W. THOMPSON.

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St. John's College,
Oxford.
Feb. 27.

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[1] G. Herzberg, *Trans. Far. Soc.*, 27, 378; 1931. R. Mecke, *ibid.*, 359.
[2] G. H. Damon and F. Daniels, *J.A.C.S.*, 55, 2363; 1933.
[3] *cf.* NH_3, F. O. Wiig and G. B. Kistiakowsky, *J.A.C.S.*, 54, 1806; 1932. R. O. Ogg, P. H. Leighton and F. W. Bergstrom, *ibid.*, 56, 318; 1934.
[4] R. G. W. Norrish, *Trans. Far. Soc.*, 30, 103; 1934.
[5] V. Henri and O. R. Howell, *Proc. Roy. Soc.*, A, 128, 192; 1930.

Activated Adsorption and Para-Ortho Hydrogen Conversion on Charcoal

THE para-ortho hydrogen conversion was used by us, among other reactions, at the suggestion of Prof. A. Frumkin, in order to investigate the chemical properties of hydrogen adsorbed on charcoal at high temperatures.

It has been shown in a qualitative way by Harkness and Emmett[1] and by Rummel[2] that adsorption of hydrogen on the surface of catalysts diminishes their activity in the ortho-para hydrogen conversion at 90° K.

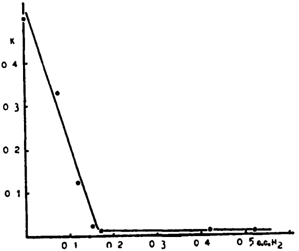

FIG. 1. Adsorption of hydrogen on charcoal at 500° C.

We have investigated the relation between the velocity of the para-ortho conversion at 20° C. and the quantity of gas adsorbed in the activated form. The charcoal was outgassed at 950°, then allowed to cool to the temperature of hydrogen adsorption, and after a definite amount of gas was adsorbed, further cooled to room temperature. The velocity of the para-ortho conversion was measured at 20° C using the dynamic method These experiments (Fig 1) have shown that the half period of the reaction τ falls in an almost linear way when the quantity of hydrogen adsorbed at 500° increases The adsorption of 0 17 c c hydrogen on 1 gm of charcoal brings down the velocity to almost zero, this quantity of hydrogen covers less than one thousandth part of the surface Further increase of the quantity of adsorbed hydrogen has practically no influence on the velocity of the reaction The poisoning action of hydrogen adsorbed at high temperatures is also observed when the para ortho conversion was carried out at 300° but the measurements in this case are inaccurate because hydrogen is already adsorbed with a measurable velocity in the activated form at 300° and the catalyst is therefore gradually poisoned during the reaction

The change in catalytic activity caused by the activated adsorption cannot be explained merely by a diminution of the van der Waals adsorption[3] as experiments which we have carried out have shown that the latter is practically uninfluenced by a previous activated adsorption of 0 17 c c of hydrogen

R BURSTEIN
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Feb 3

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[1] Harkness and Emmett *J Amer Chem Soc* 55 3496 1933
[2] Rummel *Z phys Chem* A 167 227 1933
[3] Bonhöffer Farkas and Rummel *Z phys Chem* B 21 225 1933

A Reducing Substance in Brain Tissue

EXPERIMENTS in this laboratory on the chemical basis of some histological staining reactions of brain tissue have shown that all the brain tissues examined (mouse rat, guinea pig, ox) contain a substance which has the peculiar property of reducing silver nitrate in neutral or acetic acid solution at room temperature, although ammoniacal silver nitrate is not readily reduced in the cold Extracts of brain tissue containing this substance reduce phenol 2 6 dichloro indophenol under the conditions described by Harris and Ray[1] and Birch, Harris and Ray[2] for the estimation of ascorbic acid in tissues and aqueous alcoholic extracts of ox brain tissue contain the reducing equivalent of 12–15 mgm of ascorbic acid per equivalent of 100 gm of tissue, as determined by this method But the general properties of this substance (or substances) clearly differentiate it from ascorbic acid, as shown in the following table

Brain reducing substance	Ascorbic acid
Readily reduces acid ammonium molybdate at room temperature	Does not readily reduce acid ammonium molybdate at room temperature
Does not reduce ammoniacal silver nitrate at room temperature	Instantaneously reduces ammoniacal silver nitrate at room temperature
Insoluble in absolute acetone	Soluble in acetone
Precipitated by mercuric acetate	Not precipitated by mercuric acetate
No anti scorbutic activity	Anti-scorbutic activity

Daily doses of ox brain extract containing the reducing equivalent of 6 mgm of ascorbic acid failed to prevent the appearance of the symptoms of scurvy in guinea pigs fed on a scorbutic diet, and it is clear that estimations of ascorbic acid in brain tissue by the indophenol titration method yield fallacious results

The activity of solutions of this reducing substance is easily destroyed in both acid and alkaline solutions, which renders concentration difficult, but experiments are proceeding with the view of its isolation, solutions are somewhat stabilised by the addition of cyanide, which suggests the possibility that sulphur is concerned in the activity of this substance A crystalline semicarbazone, m p 251°–252° C (uncorrected), has been isolated from active extracts, but it is not yet possible to determine whether or not this is a derivative of the active substance

The possibility of identity of the reducing substance from brain tissue and that obtained from tumour tissue by Boyland[3] and Harris[4] is under consideration but it is not proposed to name the substance from brain tissue yet

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[1] Harris and Ray *Biochem J* 27 303 1933
[2] Birch Harris and Ray *ibid* 27 590 1933
[3] Boyland, *ibid* 27 802, 1933
[4] Harris NATURE 132 606 Oct 14 1933

Serum Phosphatase in the Domestic Fowl

IT has been suggested that skeletal reserves of calcium may be available for eggshell formation in the domestic fowl[1] If this suggestion is correct, alterations in the metabolic activity of the bony tissues might be expected in association with the laying period in the hen Moreover, plasma phosphatase has been used to study alterations in calcium and phosphorus metabolism in sheep[2] and the association of increased serum phosphatase with clinical disorders of bone is now fairly well established As opportunity has arisen therefore serum phosphatase estimations have been made on birds at different stages of the reproductive cycle using Bodansky's technique[3] and his definition of the unit of phosphatase Some of the results secured so far are given

Birds used	Units of Serum Phosphatase
3 Cockerels	4 1 4 0 3 0
15 Laying Pullets	9 2 7 5, 27 1 10 2, 28 3 8 3 8 3 16 4 13·0 9 2 15 4 6 9, 27 7 16 7 22 6
2 Pullets in moult after laying	24 0 13 9
9 Pullets, sexually immature	4 4 3 2 2 0 4 3 1 7 3 8 3 6; 5 3 2 8
1 Pullet nearing laying (weight of largest ovum in ovary = 4 4 gm)	12 1

The values for cockerels and sexually immature pullets are comparable those for laying and moulting birds are higher There may well be a physiological increase of serum phosphatase in the laying hen, although it is realised that the increase may be related to functions other than bone metabolism and shell formation

The values obtained from laying birds are very variable, and it will be desirable to study these variations in relation to egg production

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[1] Common, R H *J Agr Sci* 23, 555–570 1933
[2] Auchinachie, D W and Emslie, A R G *Biochem J*, 27 351–355, 1933
[3] Bodansky A *J Biol Chem* 101 93–104, 1933

Negative Oxidation-Reduction System of *B. coli*

STEPHENSON and Stickland (1931)[1] demonstrated in *B coli* an enzyme which could catalyse the reduction of methylene blue by molecular hydrogen Examination of this reduction process discloses a striking resemblance to the hydrogen electrode

$$(1) \quad H_2 \xrightarrow{\text{bacteria}} 2H^+ + 2e$$

$$(2) \quad H_2 \xrightarrow{\text{platinised Pt}} 2H^+ + 2e$$

In other words, the bacterium behaves like a platinised platinum surface in bringing molecular hydrogen into equilibrium with hydrogen ions We have investigated the reversibility of this reaction of *B coli* using as an indicator γ γ dimethyl dipyridyl, the E_0 of which lies in the range of the hydrogen electrode from *p*H 7 9

The reversibility was tested (1) by maintaining the *p*H at a constant level and varying the partial pressure of hydrogen, and (2) maintaining the partial pressure constant and varying the *p*H The observed potentials agreed well with the theoretical potentials calculated for the hydrogen electrode under identical conditions This reversible hydrogenase system of *B coli* is the most negative oxidation reduction system as yet described in living cells The complete experimental details will be published shortly

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[1] Stephenson and Stickland *Biochem J* 25 205 1931

Origin of African House Rats

THREE main types, or mutations, are known of the common house rat (1) a grey type with grey belly (*Rattus rattus rattus*, Linnæus) (2) a brown type with grey belly (*R r alexandrinus* E Geoffroy) (3) a brown type with a creamy belly (*R r frugivorus*, Rafinesque)

From an analysis of the distribution of the wild stock it has been possible to show that this wild stock represented by *R r frugivorus* originally came from north west India the wild race inhabiting the lower Indus Valley being identical with it, this race is the westernmost of the wild local races of *R rattus* and is connected by intermediate types with the other races found in India and Malaya Rats of the stock developed from this type are common all over Africa, the white bellied type being imported by coast shipping, and the grey bellied overland up the Nile Valley so far as Uganda, in the trail of overland traffic, or even earlier with the immigration of the cattle raising tribes from the north It has recently been possible to show that in addition to the *frugivorus* stock, and its mutations, another race of Indian rat has been material in building up the house rat population of East Africa Both the wild cream bellied (*R r wroughtoni*, Hinton) and a parasitic grey-bellied mutation (*R r rufescens*, Gray) of the more rufous South Indian rat have been found on Zanzibar Island, in central Kenya, and as far inland as Uganda They probably came from India by shipping on the Bombay-Goa Zanzibar track

The possibility of analysing an introduced rat population appears to be of importance as it is much easier to trace the origin of these rats than that of either man or fleas carrying disease It will probably be found that the history of the Uganda plague centre can be reconstructed in this way It looks as if the various types keep separate, and that they differ in their biology It is not known at present whether the different races and mutations of house rats differ in their susceptibility to or immunity from plague, although certain observations would point in that direction

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March 9

An Ancient Foxtail Pine

MY young friend Mr Allan Caplan has recently obtained a remarkable series of fossil plants in the Miocene shales at Creede, Colorado Among these the conifers are especially interesting, and one specimen consists of a small cone, about 19 mm long broadly oval in form, the scales armed with long prickles (Fig 1) I sought the advice of my colleague, Dr Edna L Johnson, who at once produced some immature cones of *Pinus aristata* Engelmann, the foxtail pine of the western mountains of the United States On comparison it was impossible to see any difference Knowlton (1923) described a *Pinus crossii* from Creede, based on foliage which does not appear to differ from that of *P aristata*

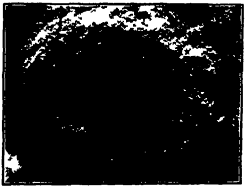

FIG 1 Cone of *Pinus aristata crossii* (enlarged) Photograph Hugo Rodeck

In common with other writers I have assumed Miocene species to be distinct from their modern relatives, even when the visible differences were slight, and such as might indicate only a variety or form in the modern flora Considering the millions of years intervening, it has seemed reasonable to assume that the species would be different and to suppose that if we had the complete plants, other differences than those recorded would be apparent What shall we do, however when there are no visible differences ?

In a paper recently received[1] on the Miocene flora of Oregon, Mr H D MacGinitie proposes a new species, *Acer negundoides*, based on fruits which he says are plainly referable to *Acer negundo*, L ' He not only fails to cite any differential characters for his species, but also expressly states that there are none, so far as the material shows Similarly, the foxtail pine from Creede appears to have no characters separating it from the living tree In such cases it appears premature to offer a new specific name, though an argument can be made, that in all probability the plants are not identical, and only appear so owing to the lack of adequate fossil materials Perhaps the most reasonable compromise would be to use trinomials, in the cases referred to, *Pinus aristata crossii* and *Acer negundo negundoides* This system at any rate enables us to avoid committing ourselves to the doctrine that the plants are positively, and in all respects, identical

From a general biological point of view, it is relatively immaterial whether the Creede fossil pine is exactly the same as the modern one The significant thing is, that it is substantially the same, and that this type of pine has existed in these western mountains of the United States from the Miocene down to the present day In all this time, like the snail genus *Oreohelix*, it seems to have occupied the same general area the higher elevations of our south west country It has not spread into Mexico British America or the eastern United States It is an isolated type, but a Californian species, *P balfouriana*, may be regarded as an offshoot from it

It seems probable that the Creede flora may be essentially contemporaneous with that of Florissant though very different in most of its species Creede is to day at a considerably higher elevation than Florissant, and presumably was so in Miocene times If two floras of the same age, but from different elevations, are preserved in a now temperate region the one from the higher elevation may be expected to resemble most that now living in the same district and hence may be regarded as more modern Very few high altitude Tertiary floras have been preserved, so that at Creede assumes more than ordinary importance

T D A Cockerell

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Dec 29, 1933

[1] Carnegie Inst Publ 416

Heredity of Aniridia

A very remarkable pedigree of aniridia was published in 1915 by an American ophthalmologist Samuel Risley It was undoubtedly issued in good faith by a man, now dead, who accepted, without verification the statement of a hospital patient who suffered from the defect This almost blind man aged 27, described the occurrence of a total absence of iris in 111 of his 119 relations in four generations, he gave, moreover, the age, or age at death, and the Christian name of most of these 119 relations, his statement was confirmed, from hospital notes, in the case of one individual only

Now this pedigree is such as to arouse instant mistrust on the part of a geneticist A few years ago I took some considerable pains to get in touch with the family to obtain support for the facts These efforts met with no success, and I was ultimately advised by the late Dr Lucien Howe, a former president of the American Ophthalmological Society, who had also inquired into the matter, that the history was entirely untrustworthy and should be suppressed

Risley could never have considered the facts presented to him by his junior house surgeon', for he even includes the statement concerning one case of *bilateral* aniridia, that the woman had one blue eye and one black eye

Unfortunately, the history has been repeatedly reproduced in America and in Great Britain, recently it has been made use of for propaganda purposes[1] It was even presented to the Prevention of Blindness Committee by a witness who was called, as an expert to advise on the prevention of blindness due to hereditary causes

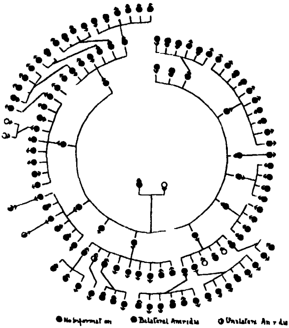

Fig 1

A warning regarding the pedigree in the Nettleship Memorial Volume' has been, apparently ineffective I therefore append a copy of the pedigree (Fig 1) and hope my warning will be supported by the publication of this letter in Nature

Julia Bell

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March 1

[1] *Eug Rev* 24 p 121 and *Brit Med J*, Jan 1934 p 96

Thermal History of the Earth

Prof Arthur Holmes has written to me to point out that I have misunderstood his meaning in his recent paper on the above subject[1] In this paper he states (p 187 and Fig 9, p 179) that the condition for permanent convection currents to be possible in the earth's crust below a certain depth is that the adiabatic and freezing point gradients of the fluid substratum should become tangential at that depth I assumed that he meant that, if the actual numerical values of the two gradients at various depths were plotted against the depth, the two resulting curves would touch at the critical depth, and that consequently if the freezing point gradient were greater above this depth it would also be greater again below it

What Prof Holmes actually intended was, that if starting at any point on the freezing point against depth curve, we plot a second curve giving the temperatures of a column of liquid in convective equilibrium, there would be a certain depth at which these two curves become tangential. This means that below this depth the freezing point gradient is less than the adiabatic gradient, which is, as is well known, the correct condition for the existence of permanent convection currents in a liquid radioactive column cooled slowly at the top and in contact at its highest point with its own solid.

On re-reading Prof. Holmes's paper and carefully examining his curves, I see that the latter view is what he expressed, and I should like to take this opportunity of apologising to him for misrepresenting his real opinion in my recent paper on 'Some Difficulties in Current Views of the Thermal History of the Earth'[2]. There is, I think, little doubt that the requisite condition will be satisfied at some depth in the crust. The available data are insufficient to fix the depth, but such as they are, point to a value of some hundreds of kilometres[3].

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[1] *J. Washington Acad. Sciences*, 23, No. 4, April 1933.

[2] *Sci. Proc. Roy. Dub. Soc.*, 21 (N.S.), No. 2, 10 Jan. 1934.

[3] Jeffreys, H., "The Earth", 2nd Ed., p. 141, and Poole, H. H. and Poole, J. H. J., *Phil. Mag.*, p. 666, March 1928.

Surface Markings of the Henbury Meteorites

DR. L. J. SPENCER, in describing the Henbury meteorites[1], states: "The surface markings . . . in all cases appear to be the result of sculpturing by weathering processes. No clear evidence was detected that the original surface on any of the masses had been preserved." Having examined nearly all the irons found at Henbury, both by our parties from the Kyancutta Museum and by prospectors and others, I consider that Dr. Spencer's statement needs qualification.

The irons buried to considerable depths are certainly rusted and have lost all resemblance to the original surface markings, and the same is true to a less extent of the buried portions of those irons which were only partly exposed, whilst other rusted irons have been at one time buried, but exposed later by lowering of the ground surface. Omitting further reference to these rusted irons, there remain two groups of material which I regard as exhibiting clearly the original surface markings.

The clearest evidence of unweathered condition is found in many of the twisted slugs torn from crater meteorites in landing or in the subsequent explosion. These have cuts, scratches and bruises which cannot be attributed to wind erosion or other forms of weathering, but are as clear and fresh as if recently made. This evidence, if accepted, indicates a probability that some of the individual irons may be in equally fresh condition, and several such have been actually found. (See Plate XV, Fig. 10, 1 c.) These 'individual' irons show a variety of surface markings. Apart from the rust pitted, partly buried surfaces, and the 'pock marks' which are admittedly the result of atmospheric weathering, these markings may be classified as (1) blebs, bosses and rounded ridges, somewhat resembling brain convolutions, (2) 'gouge marks', well shown in the plate mentioned, (3) wide, very shallow concavities. I am inclined to relate these three types respectively to the forward, lateral and hinder parts of the meteorite in flight; but all three types are not necessarily present on a particular specimen, the variation being perhaps due to the amount of rotation and the general shape.

An interesting point is that the size of these markings corresponds roughly with the size of the iron. Thus the gouge marks in the iron of 33 lb. shown in the plate mentioned average ½ in. across, those on a very perfect little 4 oz. iron are only ⅛ in., and those on the largest iron I have seen average an inch. This grading of size would be difficult to explain on the assumption of atmospheric weathering, but on that of flight pitting it may be accounted for by the fact that small irons would lose their velocity and incandescence in the upper rarified air, whilst large ones would retain these in the lower denser levels.

The totally different surface markings of an individual meteorite and a slug cannot be accounted for by weathering. Irons of both kinds, lying on the surface, have been exposed to identical conditions, and had a substantial thickness of iron been removed by weathering, the surface sculpturing of both varieties should tend to approximate, as is admittedly the case with buried and rusted irons.

Not only do the best of the individual irons show these clearly defined forms on their exposed surfaces, but in many instances, especially in recesses of pits, there remain traces of a peculiar even scale, which I regard as the original scale formed in flight. This, in common with the remainder of the exposed surface, is covered by a limonite glaze of secondary origin, due to hydration of a thin film of the original surface scale and iron; this glaze forms an extremely hard protective patina and may be responsible for the perfect preservation of the surface features.

The flight pitting of an iron meteorite differs from that of a stone one. Stone is only subjected to incandescence and gaseous flow (compare the welding torch of an oxy-acetylene blowpipe), whereas iron is subjected to oxidation as well (compare the 'cutting torch' in which an additional nozzle sprays oxygen on to the incandescent metal). Nor will the flight pitting of irons which have been observed to fall necessarily duplicate the features of the Henbury irons, which are known by their crater effects to have been of exceptionally high velocity.

R. BEDFORD.

Kyancutta Museum,
Kyancutta, South Australia.

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[1] *Min. Mag.*, Sept. 1933, p. 390.

THE preservation of the fine series of material, now in the meteorite collection of the British Museum, from the meteorite craters recently discovered near Henbury in Central Australia is entirely due to the energy and enthusiasm of Mr. R. Bedford. This material, 1,000 lb. in weight, was collected by him, and he has given much thought and study to the matter on the spot. The numerous individual masses of meteoric iron show a considerable variety of surface forms and markings which are certainly puzzling. Some of them he admits are due to subaerial erosion and some to subterranean weathering. But others he believes are the original surfaces; that is, those resulting from the friction and burning of the meteorites during their brief flight through the earth s atmosphere This I concluded could not be the case for the following reasons

(1) None of the masses shows the thin jet black skin on smooth rounded surfaces characteristic of freshly fallen meteoric irons

(2) None of the polished and etched sections shows an exterior heating zone (with granulation, due to the transformation of α iron to γ iron at about 850° C)—proving that the masses are weathered remnants

(3) Some of the masses show various stages of breaking up, from the penetration of iron oxides along cracks to the detachment of flakes

(4) Iron shale of various types is found in large amount in close association with the meteoric irons, and has evidently been formed by the weathering of the masses

(5) Each crater must have been formed by the fall of a single large mass of iron, which became broken up by the force of the gaseous explosion If the meteorites had fallen as a shower of individuals of the sizes now found, they would have met with a relatively greater air resistance, and no crater would have been formed (Large meteoric stones are broken up in the air and fall as a shower without the formation of a crater)

The curious striæ and other markings on the surface of the 'slugs', commented on by Mr Bedford, may perhaps be explained by the weathering of strained and twisted metal These slugs' show a contortion of the lamellar crystalline structure, and they were evidently torn from the main mass by the force of the explosion

L J SPENCER

British Museum (Natural History),
South Kensington,
London, S W 7
Feb 15

The British Coal-Tar Colour Industry

WHILST the original discovery of a coal tar dye was made by an Englishman, W H Perkin in 1856, and the early industrial development of the dyestuff industry took place in Great Britain, the rapidly growing industry soon found better conditions for its development in Germany The consequent decline of the British coal tar colour industry was already well marked in 1875, and in 1886 had proceeded so far that 90 per cent of the dyes then used in Britain were of foreign manufacture This condition of things persisted and, in the decade prior to the War, German domination of the industry was nearly complete

It is not an overstatement to say that the development of this highly scientific and extremely profitable industry in Germany instead of in Great Britain had enormous, if not decisive, political and economic effects both before and during the War It has also been an important factor in shaping the world conditions of the present day An immediate effect was that, in the very early days of the War, one of our great industries, that of the manufacture of textiles, which was of vast importance both on the military and civil fronts, was threatened with strangulation With the view of affording information regarding the origin and uses of dyestuffs, I published in 1915 a compilation of important addresses given on the subject papers published between Perkin's original discovery in 1856 and 1914 and papers published during the War period[1] On the publication of this book a letter was received from Sir John Brunner which contains a statement of his opinion that, with sufficient financial backing, the colour-manufacturing industry might have been developed here instead of in Germany

In view of the remarkable success of the firm of Brunner, Mond and Co , the considered opinion of Sir John Brunner on this point is of great historical interest and importance

The letter, which is published with the approval of Sir Felix Brunner, Bt , the grandson of Sir John, is subjoined

WALTER M GARDNER

Lawnhurst,
Didsbury,
Manchester

Silverlands,
Chertsey
Nov 7th, 15

Dear Mr Gardner,

I am greatly interested to read the advertisement of your new book on The British Coal Tar Industry"

When my brother Henry returned in 1857 from his studies at the Polyteckmkum at Zurich he entered the service of F Crace Calvert, who was then the public analyst of Manchester

He used to come home to my father's house at Everton every Saturday, and show us, from 1858 to the beginning of 1861, skeins of silk treated with aniline dyes that he had himself prepared

We were in our teens and we never got any farther than enjoying the colours

I have many a time reflected that if he and I had had the command of money, which came to us in later life, that the Coal Tar Industry would never have gone to Germany

Yours faithfully,
John Brunner

W M Gardner, Esq , M Sc , F I C

Technique of Height Measurement of the Ionosphere by the Pulse Method

IT has been shown[1] that in the pulse method of Breit and Tuve for the measurement of the heights of the regions in the upper atmosphere from which wireless waves are reflected, the quantity to be measured is the equivalent path $c\int ds/U$, where U is the group velocity along an element of path ds and c is the velocity of light The group velocity U is, by definition, the velocity of the crest of the disturbance Now the crest is by no means an obvious point in the photographic registration, and it has been usual therefore to refer measurements to the beginning of the pulse A great deal of ingenuity has been called forth in making this point readily recognisable, by shortening the pulse, increasing the rate of build up, etc , so that errors due to variation in amplitude may be reduced to a minimum. Errors due to dispersion have been ignored or accepted as inevitable

Since the crest is the point of greatest importance it must be *made* obvious Consider the pulse shown in Fig 1 (*a*); there is no point on the curve that is obviously defined But if we differentiate it we obtain the curve of Fig 1 (*b*) and we see that three points, corresponding to the beginning, crest and end of the pulse, are clearly indicated, for they cut the zero line at an angle and this angle can be made as large as we please by increasing the amplitude If we differentiate a second time obtaining the curve of Fig 1 (c), we define the beginning and end still more accurately since there are discontinuities at these points and we also define the points of inflexion of the original curve So that first, we can readily measure the quantity we wish to measure and secondly, we have four other points available for the measurement of distortion or of dispersion of the pulse

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[1] The British Coal Tar Colour Industry its Origin, Development and Decline By Walter M Gardner Pp 487 London, 1915 Williams and Norgate

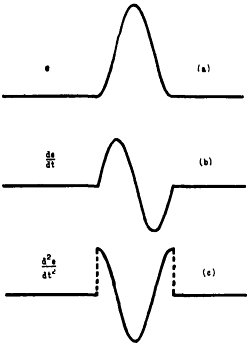

FIG 1

The differentiation of such a pulse is an operation which can be performed very simply by an electrical circuit and all that is necessary is to connect a large capacitive impedance in series with a relatively small resistance across the output of the receiver normally used for echo delineation, to amplify the voltage across the resistance and to apply the output from this amplifier to the cathode ray oscillograph in place of the receiver output A second capacitance resistance potentiometer across the output of the amplifier will give the second differential of the pulse

The use of the differential curve in place of the pulse itself results in a number of practical advantages, quite apart from those already mentioned When taking continuous records of heights with either time or frequency as the second variable it is customary to select a strip of the echo pattern by means of a narrow slit, in all the systems in use, disturbances, such as noise, decrease the contrast between the trace and the background, whereas by using the differential curve the definition of the trace indicating the peak of the pulse is practically constant, though that of the beginning and end are affected as before The band width of the component frequencies of the pulse indicated above is quite restricted compared with that necessary for the same accuracy of measurement by the usual method, for there are no abrupt changes in the rate of increase of amplitude it can be shown that heights greater than about 100 km can be measured to an accuracy better than 1 per cent using a band width of only 1 kc/s this incidentally resulting in a considerable increase in the signal/noise ratio If we require resolution better than 100 km, we are forced to use band widths correspondingly wider the actual resolution being inversely proportional to the band width By using the differential curve in place of the pulse proper the resolution is increased twofold and if the second differential is used and the pulse is symmetrical we have a further twofold gain the above follows directly from a consideration of overlapping pulses The technical difficulties of producing such a pulse are not at all serious Finally in those cases where a common control frequency is not available at transmitter and receiver and a self synchronising scheme has to be devised it becomes feasible to use the ground ray to start the time base In such cases though a portion of the up stroke may be missing the important part the peak, can be made to occur on the time base so that no loss of accuracy results

Fig 2 shows a record taken at these Laboratories using a differential curve in place of the pulse itself The beginning of the ground ray is not visible for a pulse tripped time base as mentioned above is in use At the lower edge of the record is the fine black line defining the peak and just above it the edge defining the end of the ground ray Along the middle of the record runs the trace of an echo reflected from the Appleton region at a height of 300 km and the central line corresponding to the peak is clearly defined For recording the base line only of the echo pattern is visible as in the method described by Builder[2] Note that the same definition of the central line could be maintained for a height scale some 5–10 times as great so that measurements to an accuracy much better than 1 per cent should be attainable though light intensity considerations may then become the limiting factors The echo recorded was a very simple one but even if it should be complex we record more information with greater accuracy by this method than by direct pulse delineation

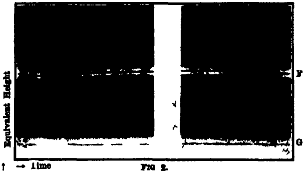

FIG 2

O O PULLEY

Halley Stewart Laboratories
King's College London
Feb 17

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[1] E V Appleton *Proc Phys Soc* 41 43 1928 J C Schelling *Proc Inst Rad. Eng* 16, 1471 1928

[2] G Builder *J Inst Elect Eng* 73 443 Oct 1933

Apparent Clustering of Galaxies

A CONSIDERABLE amount of material on the distribution of external galaxies has become available through the publication of the Harvard and Mount Wilson surveys Shapley and Hubble have both discussed the observed irregularities in the distribution of these galaxies Shapley emphasises the non uniformity of the distribution of matter in the metagalaxy Hubble finds that statistically uniform distribution of nebulæ appears to be a general characteristic of the observable region as a whole , and hesitates to admit the reality of clusters or groups of galaxies with the exception of the few that are readily recognised as such Statistical analysis of the available material is now possible , and as the comparison between the observed distribution curves corrected for the effect of dispersion in the limiting magnitudes and the theoretical frequency curves computed on the assumption of random distribution has yielded some rather definite results it seems worth while to communicate them in advance of publication in more detail

The Shapley Ames catalogue of galaxies brighter than the thirteenth magnitude[1] exhibits conspicuous deviations from a random distribution Both galactic polar caps were divided into a number of equal areas (well known clusters being excluded) and the number of galaxies was counted in each area The observed frequency curve had a much larger dispersion than the theoretical curve computed on the assumption of random distribution The accompanying table shows conclusively that the irregularities in the distribution cannot have been caused by galactic or extragalactic absorption

North Galactic Polar Cap

No of galaxies (Shapley Ames)	$\overline{\log N}$ (Hubble)	No of galaxies (Shapley Ames)	$\overline{\log N}$ (Hubble)
½	1 92	15	1 79
1½	1 99	17	1 85
4	1 86	18½	1 87
5½	1 90	22	1 96
6½	1 88	24	1 95
10	1 87	26	1 87
10½	1 88	29½	1 86
12½	1 87	31	1 88
14	1 83	31½	1 86
14½	1 95	36	1 94
14½	1 93		

The first column of this table gives the number of galaxies counted for one of the areas in the Shapley Ames catalogue The centres of 9 13 survey fields used by Hubble in his study of the distribution of faint galaxies (down to mag 19 5) fall within the limits of each area and the second column of the table contains the mean value of log N for these faint galaxies The absence of any progression in the values of $\overline{\log N}$ shows that the deviations from random distribution are due to a real clustering of galaxies and are not caused by the absorption of light in space

Both the Mount Wilson[2] and Harvard[3] surveys of faint galaxies show evidence of clustering The diagram (Fig 1) gives a comparison between Hubble's observed distribution curve (dots), corrected for a dispersion of ±0 15 mag in the limiting magnitude of the Mount Wilson plates and the theoretical curve (crosses) computed on the assumption that the galaxies are distributed at random

Similar deviations from random distribution are found in the Harvard material The observed frequency curve in log N has for the north galactic polar cap a dispersion of $\pm 0\ 25$ and as the maximum value of the error dispersion amounts to only $\pm 0\ 15$ (most probable value $\pm 0\ 09$) the true dispersion must be of the order of $\pm 0\ 20$ in log N The dispersion computed theoretically for random distribution is not larger than $\pm 0\ 03$ in log N For the south galactic polar cap the discrepancy is even greater We should in addition consider Shapley's elegant and definite proof for the presence of clustering in nine regions[4]

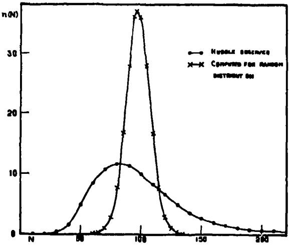

FIG 1

We can scarcely escape the conclusion that a widespread tendency towards clustering among galaxies is one of the chief characteristics of our universe

BART J BOK

Harvard Observatory
Cambridge Mass
Jan 27

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[1] *Harv Ann* 88, No 2 1932

[2] *Astrophys J*, 79 8, 1934

[3] *Harv Bull* 889 1932 Harvard Reprint 90 1933

[4] *Harv Bull* 890 1932

An Arithmetical Prodigy in Egypt

A BOY of unusual arithmetical ability named Mohammed Ismail Turki El Attar has recently died in a Government asylum in Cairo He was the son of a grocer in a small country village near Teh el Barud in the Delta and when first discovered used to make a precarious living by exhibiting his powers as a calculator in cafés in Cairo He was unable to read or write and was obviously a boy of poor general intelligence His powers were tested on various occasions The following is a summary of some of the calculations he performed mentally

The squares of numbers of two digits were given correctly almost instantaneously, but there was occasionally hesitation in giving the products of pairs of two digit numbers Products and squares of 3 digit numbers were given in times varying from eight to forty five seconds Cubes of 2 digit numbers were worked out in from two to three minutes while the product of two numbers of 10 digits was worked out correctly in twenty minutes

8^{16} was correctly computed in five minutes, 5^{10} in twenty seconds and 6^{10} in seventy seconds.

Division was a slower process and 9 digits divided by 3 took times varying from two and a half to seven and three quarters minutes.

Square roots of 6 digit numbers were extracted in less than a minute while cube roots took longer. Curiously enough, the memorising of a number of 27 digits was not done successfully, although he could repeat questions which had been put to him and their answers after some days had elapsed and would break off calculations in the middle to ask for milk or cigarettes, taking up the calculations again where he had broken off. His methods of working were not discovered but he had obviously memorised the squares of two digit numbers, and less completely the products of two digit numbers.

Though the arithmetical powers of this boy were surprising, they were not comparable with those of some of the calculating prodigies described by Rouse Ball in Mathematical Recreations and Essays.

The boy was a good illustration of cases of arrest of mental development in which normal or even phenomenal mental capacity is observed in certain limited directions such as memory, calculating ability, musical ability, etc. He was so defective in respect to other mental faculties that he was unable to adjust himself to ordinary conditions of life and became an inmate of the mental hospital.

He died in the hospital at nineteen years of age. The autopsy disclosed that he had a softened patch, probably an old hæmorrhage, in the right occipital region of the brain, about the size of a small hen's egg. A recent hæmorrhage at the same place of the brain was the cause of his death.

H. W. DUDGEON.
H. F. HURST.

Cairo.
Feb. 24.

Determination of Sex

THOSE who are interested in the heredity of sex will be grateful to Prof. MacBride for again exposing *in these columns*[1] the *naïveté* of some early views of this problem (which he attributes to Morgan). Especially will they be reassured by his conclusion. He points out that sex is essentially the same thing wherever it occurs. He concludes — "It seems clear that there are fundamentally *opposed* male and female constitutions, but that the constitution of every individual is a mixture of the two, and that the structural manifestations of sex depend on the *proportion* of these constitutions and on which gains the upper hand in development" (italics mine).

This view is somewhat similar to that reached by way of experimental genetics. Thus Goldschmidt, reviewing his experiments since 1910[2], states that "the resulting sex is dependent upon two genetic somethings, one of which shifts sex towards the female, the other towards the male side". Again, Morgan's colleague Bridges[3] says that 'both sexes are due to the action of *opposed* sets of genes, one set tending to produce the characters called female, and the other to produce the characters called male. These two sets of genes are not equally effective, for in the complement as a whole the female tendency genes outweigh the male tendency genes and the diploid (or triploid) form is a female. When the *relative number* of the female tendency genes is lowered by the absence of one X, the male tendency genes outweigh the female and the result is the normal haplo X male."

Thus, as my italics show, the experimental geneticist seems to agree with what Prof. MacBride has expressed in more generally intelligible language, not only in admitting the essential sameness of sex in all organisms but also in understanding the function of proportion in its determination in some of them. Unanimity among the different branches of biology has therefore been reached after a long period of divergence from entirely different data and, what is more, apparently unawares. Such an event, surely, should not be allowed to pass without notice and without applause. The usual view that the chromosome theory of sex determination criticised by MacBride was a special hypothesis put forward by McClung in 1902[4] and therefore not attributable to Morgan, who accepted the hypothesis only in 1911[5], should perhaps also not pass without mention.

C. D. DARLINGTON.

John Innes Horticultural Institution,
London, S.W.19.
March 14.

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[1] NATURE, 133, 359 March 10 1934
[2] *Quart Rev Biol* 6 127 1931
[3] *Amer Nat* 56 59 1922
[4] *Biol Bull* 3 43 74 1902
[5] *Science N S* 33 839 1911

I AM delighted to find that such a distinguished cytologist as Dr. Darlington, though a long compass round be fetched, has arrived at somewhat similar conclusions to those to which I myself have been led respecting the nature of sex. I do not, of course, view the gene in the same light as he does; but since in an article shortly to be published in NATURE I have given my views as to the nature of the gene, Dr. Darlington and I need not quarrel about the matter now.

E. W. MACBRIDE.

43 Elm Park Gardens,
Chelsea, S.W.10.
March 17.

Ergine

RECENTLY we showed[1] that the four ergot alkaloids (ergotoxine, ergotinine, ergotamine and ergotaminine) by treatment with alcoholic potassium hydroxide give rise to a crystalline base ergine, which constitutes about half the parent molecule.

We have since proved that ergine is the amide of an acid $C_{15}H_{15}N_2 \cdot COOH$ and further analyses of ergine and its salts show that the formula for ergine requires correction to $C_{16}H_{17}ON_3$, in agreement with the formula for the acid now isolated.

Jacobs and Craig have published a paper[2], in which they have described the action of alkali upon ergotinine and the isolation of a crystalline acid, $C_{16}H_{16}O_2N_2$, which they name lysergic acid. We have no doubt that this is identical with that prepared by ourselves from ergine.

S. SMITH.
G. M. TIMMIS.

Wellcome Chemical Works,
Dartford,
Kent.
March 27.

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[1] *J Chem Soc* 1543 1932
[2] *J Biol Chem* 104 547 1934

Research Items

Neolithic Age in Western Europe Recent interpretation of archæological evidence has shown an increasing tendency to reduce the duration of the neolithic age as against the claims of the mesolithic and bronze ages, until, as a period, it has seemed in danger of extinction In Britain, recent researches notably the pottery analyses of Mr Stuart Piggott, have placed the neolithic on a more assured basis, and a similar service is performed for the neolithic and chalcolithic periods of western Europe in *Antiquity* of March by Jacquetta Hawkes As a starting point is taken an early culture which is identified in south and east France It passed, presumably up the Rhone Valley, to the western Swiss lakes, where it became established in the first Danubian period Thence it passes to Britain without touching Brittany It is not yet possible to determine the exact limits of distribution of this culture In the next phase, a period of differentiation one offshoot, coming under Danubian influence, forms the Michelsburg culture, while another branch, spreading westward, joins with an influence from southern France producing a more sophisticated type of pottery and is responsible for the Chassey culture This spreads farther westward and joins with other elements to produce the elaborate chalcolithic culture of Brittany Cutting across this western culture from Belgium to the Channel Islands is the Seine Oise Marne culture, of which the most characteristic feature is the vase with everted rim well marked shoulders and splayed foot The pottery of this last named culture, it has been suggested shows a relationship with that of the peoples who in the meanwhile and after severe flooding had resettled the western Swiss lakes their culture showing affinities with that of their predecessors but developing new features

Birds' Bones from Prehistoric Eskimo Ruins On St Lawrence Island in the Bering Sea Eskimo habitations dating from more than 2 500 years ago to village sites of half a century back have been excavated during several seasons, and several thousand bones of birds have been found amongst the food refuse In all, 45 species were represented, ten of them new to the fauna of the island (H Friedmann, *J Washington Acad Sci* **24**, 83, Feb 1934) Commonest in all sites of all ages (found in 69 diggings) was Pallas's murre (*Uria lomvia arra*), still the most abundant bird on the island The other birds generally used for food included the crested and paroquet auklets, the Pacific and king eiders, the latter more common than the former in the older diggings, contrary to their relative abundance to day, and, curiously enough, the pelagic cormorant (*Phalacrocorax pelagicus*), represented from the most ancient to the most recent site Other pelagic birds include fulmars, shearwaters and the short tailed albatross Considering the difficulty of obtaining such birds, it seems strange that birds so large and so abundant on St Lawrence Island as geese should be poorly represented, the more so as geese are now much hunted for food by the Eskimos

Transposed Hinge Structures in Lamellibranchs. Under this title, W P Popenhoe and W A Findlay describe several cases of valves with the hinge elements *reversed, those normally occurring in the right being* found in the left valve, either wholly or partially (*Trans San Diego Soc Nat Hist*, **7**, No 26, 1933) The relations of the individual teeth to one another, and to the bilaterally symmetrical parts of the shell, are exactly similar to the relationships which are present in the normal individual The shells in question belong to the genera *Venericardia*, *Astarte*, *Transennella* and *Unio* Many other genera were examined, chiefly venerids and tellinids, but out of 2,000 no reversed specimens were seen The dentition in these abnormal forms may be completely or partially transposed but no complete transposition involving cardinals, anterior and posterior laterals has been found in this study The tendency is for the cardinals and anterior laterals to transpose together The posterior laterals, which are formed independently of the others, do not usually transpose In rare cases the posterior laterals transpose and not the cardinals This hinge transposition has usually been regarded as a very rare phenomenon, even rarer than the comparable abnormality of inverse coiling in gastropods but these notes show *that it takes place quite as frequently* as in *some of* the helices in which reversal is much easier to see The authors are of the opinion that the abnormal hinges described represent examples of a systematic abnormality, *not pathogenic except in very rare cases*, in which certain of the primary lamellæ from which hinge teeth are derived have developed in the opposite valve from that in which they are normally found

Atomic Composition of Plants in Relation to Atomic Number Summarising the results of large numbers of analyses, Vinogradov (*C R Acad Sci*, **197**, 1673, 1933) claims that the relative number of atoms of any chemical element present in living matter tends to be inversely proportional to the atomic number of that element The curves showing this relation also tend to show a regular periodicity Maxima occur, for example at atomic numbers of 18 36 54, 72 and 90 and special significance is claimed for the elements found at these and at other periods It may be noted that no biological function is at present known for most of these significant elements

Replacement of a Bud by Roots Mr Samuel Sandison writes from the Department of Botany, University College, Dundee to report a striking case noted during some observations upon the propagation of *Forsythia suspensa* by cuttings Usually roots arise from buds at the basal end of the cuttings and always from the basal half of the bud In this case when the bud scales were stripped off, the bud apex had disappeared and in its place five roots were seen arising from a common point of origin, somewhere about the original base of the bud

Pigment of *Aspergillus* Spores Further results of his investigations on aspergillin, the brownish black pigment of the spores of *Aspergillus niger*, have been recorded by Dr Adolfo Quilico in *Rend R Ist Lombardo Sci Let*, Parts 11–15, 1933 This pigment exhibits an acid character, which is ascribed to the presence in its molecule, not only of phenolic hydroxyl groups, but also of carboxyl groups It is, indeed, able to displace carbon dioxide from alkali and alkaline-earth carbonates, and, when heated to

150°–250° C, it liberates appreciable amounts of carbon dioxide and water, at the same time losing its solubility in alkalis When oxidised by hydrogen peroxide, it yields, together with acid products not yet characterised, mainly mellitic acid, which is also formed, along with a small amount of oxalic acid, on oxidation with nitric acid Consideration of the chemical behaviour indicates that aspergillin is a typical humic acid, analogous to that extractable from peat, lignite and soil This is the first known case of the formation of a humus substance in a vegetable organism from a carbohydrate such as sucrose, and is of interest as a contribution to the problem of the genesis of humic matters Unlike peat, etc, the *Aspergillus* spores yield a particularly pure humic acid, which lends itself well to chemical investigation

Scolt Head Island A study of the physical processes at work on the north coast of Norfolk has led to some interesting conclusions with regard to this island, which lies to the east of Brancaster In a lecture to the Royal Geographical Society on March 12, Mr J A Steers discussed the relative effects of tidal and wave action on this coast The island apparently began by wave action separating the shingle from the sand on an extensive foreshore, a stage that can be seen at other places on that coast A shingle ridge near high water mark formed an off shore bar, became more stable, extended westward by wave action and formed a recurved end Dunes formed on its surface Newer ridges were added by wave action to the main ridge and pushed backwards, a process that can still be seen in action At other times the new ridges were of sufficient size to form permanent additions to the island The island lies not parallel with but at a slight angle to the coast Wave action would tend to build at right angles to the coast line, but this would force the distal end into deep water and so subject it to greater wave action, which necessarily drives it back The island is about four miles long, with a width that varies with the state of the tide The dunes show various stages of consolidation, and between them lie salt marshes which increase in height from the younger in the west to the older in the east

The Constant Pressure Air Thermometer A number of careful determinations of the volume coefficients of condensable gases have been made by Coppock and Whytlaw Gray using the Callendar compensated thermometer (*Proc Roy Soc*, A, Feb) The gases used were ethylene, air, carbon dioxide, dimethyl ether, nitric oxide, carbon monoxide and sulphur hexafluoride, under pressures up to 1 metre of mercury The gases were carefully purified and butyl phthalate was used as a manometer liquid The values obtained with a glass bulb, when extrapolated to zero pressure, gave values for the coefficient layer, then the perfect gas' value, and this was ascribed to adsorbed gases on the walls of the vessel These are liberated as the temperature rises and give values for the coefficient which are too high The difference was less marked for a fused silica containing bulb, and the authors suggest that silica is a suitable material to adopt as a standard in determining the volume coefficient for condensable gases

Positive Electrons from Lead ejected by γ-Rays In a communication which was unfortunately too long for use in our correspondence columns, but will, we hope, shortly be published elsewhere, Dr A Alichanow, of the Physical Technical Institute, Leningrad, describes measurements of the velocity distribution of the positive electrons ejected from lead by the γ rays of radium C′ A semicircular focusing apparatus was used, and the electrons were detected by coincidence counts in two contiguous Geiger Muller counters Two pronounced and two subsidiary maxima were found in the distribution curve which appear to agree well with the known γ rays of energy greater than 1 78 × 10⁶ volts Similar measurements were also carried out with a source of radon enclosed in a thin glass tube, and also in this case positive electrons were found with a somewhat similar velocity spectrum The total number of the positive electrons in the latter case is 0 5–1 per cent of the number of β rays of the corresponding continuous spectrum This is in agreement with the measurements of Dr Skobeltzyn, whose experiments are described in a letter in this issue of NATURE (p 565), where he points out the problems raised by this result

Isotopes of Hydrogen In three preliminary notes in the *Proceedings of the Royal Academy of Sciences of Amsterdam* (36, Nos 6 and 7, 1933, 37, No 1, 1934) Zeeman and de Gier reproduce very clear parabolic traces obtained by the use of the J J Thomson mass spectrograph with gases containing hydrogen isotopes and inert gases Curves were obtained which could be interpreted as belonging to hydrides of the inert gases since they do not exhibit multiple charges Various kinds of ions were detected $(H_2^1H^2)^+$, $(H^1H_2^2)^+$, $(H_3^2)^+$, and others due to traces of impurities in the apparatus The mass differences between He and $H_2^1H^2$, HeH^1 and $H_1H_2^2$, $HeH^2{+}$ and $H_2^2{+}$ were measured with some accuracy In an experiment with hydrogen obtained by passing water vapour over sodium, a faint parabola with $m/e = 4$ was obtained after an exposure of half an hour, and the hydrogen isotope was thus detected without previous concentration

Structure of some Platinum and Palladium Compounds. Chemical and X ray experiments by Cox Saenger and Wardlaw (*J Chem Soc*, 182, 1933) with the dimethyl sulphide derivatives of platinous and palladous chlorides, $[Pt(Me_2S)_2Cl_2]$ and $[Pd(Me_2S)_2Cl_2]$, indicate that the two isomeric forms of the former are planar *cis trans* compounds The α form is the *trans* compound, not the *cis* compound as was suspected by Werner, or a tetrahedral configuration as suggested by others The results with the β isomer are less definite, but it seems likely that the sulphur atoms are in *cis* positions and that the compound is ionised in the solid state In the case of the palladous compound, only one form was obtained, which is isomorphous with the α platinous compound and is therefore no doubt the plane *trans* compound The chemical reactions of the substances differ very considerably, particularly with silver oxide The β platinous compound reacts rapidly with silver oxide with production of silver chloride and a basic substance, which forms an alkaline solution in water and reproduces the original compound with acid The α form, on the other hand, reacts only slowly, with evolution of dimethyl sulphide and precipitation of platinum, as hydroxide or oxide A so called third form of $Pt(Me_2S)_2Cl_2$ had been shown by Tschugaev and co workers to be really the plato salt, $[Pt(Me_2S)_4]$ $[PtCl_4]$, a result confirmed by the present investigators

Ground Levels in Bihar in relation to the Earthquake of January 15, 1934

By Col Sir Sidney Burrard, Bt, F R S

IN an article published in Nature of February 17, p 236, Dr de Graaff Hunter has endeavoured to show that the surface of the plains where the earthquake of January 15 occurred in India had been proved by levelling to have been rising in height throughout the present age, at the rate of 4½ ft per century This conclusion is so important that I feel justified in submitting my reasons for questioning it Dr Hunter bases his theory on the results of levelling but these are not confirmed by the geographical facts of Bihar The accuracy of levelling is estimated from the agreement between two independent levellers Although they take independent observations, they work together and there are sources of error which affect them both

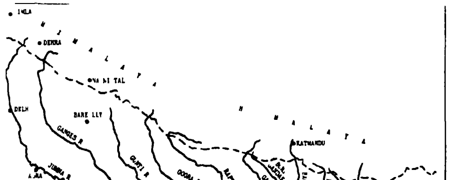

Fig 1 Rivers of Bihar

The history of levelling has placed on record several examples in Egypt, India and France of errors being accumulated and being only discovered when the levelling was connected with mean sea level We have no mean sea level in Bihar, and the only check here upon levelling errors is provided by the rivers (Fig 1) The numerous rivers that traverse the flat plains are governed, like sea level, by gravitation The surface of the plains differs in form from that of the sea, in that they have a gentle slope from north to south and a still gentler slope from west to east The combination of these two slopes compels the numerous rivers, as soon as they escape from the Himalaya, to follow courses that converge upon the south east corner of Bihar It is perhaps not strictly correct to say that the slopes determine the courses of the rivers, for the rivers have created the slopes If Bihar were at sea level, its surface would be spheroidal, but as it is raised above the sea by two hundred feet of unconsolidated alluvium, the rivers have so shaped its surface that they may reach the sea along curves of least resistance The adjustment of the surface to the rivers is very delicate, and it is not possible to say that either is the governing factor their co operation is perfect

The rivers have to carry immense volumes of water from the Himalayan snows across densely inhabited level plains, and although they have the guidance of skilled engineers, a constant rise of the ground level across their paths would upset their balance and deflect their courses No such results have been observed in confirmation of the levelling theory

It may even be doubted whether a flat surface overlying alluvial depths could possibly be raised 4½ ft per century as the levelling theory assumes If any area of alluvium were to be raised above the normal level of the surface, or above the normal saturation level the rise would probably be converted into blown sand', and would be removed by winds

Dr Hunter s conclusion that the surface of the earthquake area has been rising 4½ ft a century is based upon three levelling results — Pirpainti, Benares and Dinajpur

Pirpainti Levelling A discrepancy of 3 178 feet was discovered at Pirpainti, when in 1929 a new line of levels intersected the old line of 1862 Dr Hunter believes that this levelling discrepancy of 3 178 feet denotes a rise in the height of Pirpainti between 1862 and 1929 I find it difficult to place such faith in the accuracy of this levelling Pirpainti is a station of the East India Railway the levelling along this railway was carried out in 1862, the levellers were inexperienced, their instruments were primitive When the bench mark was originally cut at Pirpainti station, it was not intended to be a standard datum for scientific observations No pendulum observer would take observations in this railway station I feel that the discrepancy of 3 178 feet at Pirpainti may be due to an accumulation of errors arising from the instability of the site, from the inexperience of the levellers in 1862, and from the secondary' character of the check levelling in 1929

Benares Levelling A discrepancy of 2 170 feet was discovered at Benares when in 1916 a new line of levelling intersected the old line of 1863 This discrepancy is attributed by Dr Hunter to the rise of Benares between 1863 and 1916 The levelling in 1863 to Benares was a continuation of the Pirpainti line, and its result is dependent on Pirpainti The levelling of 1916, which first disclosed the discrepancy of 2 170 feet at Benares, was brought from Calcutta across the mountainous region of Hazaribagh This levelling was carefully observed but no levelling over mountains can have a high degree of accuracy The rays to the fore and aft staves are exposed to unequal refraction I do not think that the level of the flat plains of Bihar can be tested by mountain levelling A bench mark on Hazaribagh rock would be a reliable standard datum for Bihar, provided it were not high up but on a steep ascent levelling accuracy deteriorates

Dinajpur Levelling In 1900 (after the publication by the Geological Survey of the memoir on the great earthquake of 1897) a line of levels was carried across Bengal from south to north from Calcutta to Dinajpur by Capt H I Crosthwait and Lieut H M Cowie this line was in every way scientific and the height of Dinajpur was determined as accurately as was possible In 1925 a new line of levels intersected the 1900 line at Dinajpur The discrepancy between the 1900 and the 1925 results was 0 963 foot

Dr Hunter assumes this discrepancy of 0 963 foot to be due to the rise of Bengal between 1900 and 1925 and he converts the observed error of 0 963 into a theoretical rise of 4 feet in 100 years Dr Hunter s procedure is based upon the assumption that there was no levelling error on either of the lines that met at Dinajpur Such an assumption is contrary to experience If we bear in mind that the 1925 level line had to pass through the streets of Calcutta and to cross the Hugli and that both the 1900 and 1925 lines had to cross the main stream of the Ganges we may feel justified in thinking that a discrepancy of 0 963 foot in 500 miles is within the limits of accumulated error

The safest way of proving whether Dinajpur has risen in height would be to re observe the whole levelling line of 1900 bench mark by bench mark from Calcutta to Dinajpur A single intersection of this line by another line does not furnish convincing evidence

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By Dr J de Graaff Hunter C I E

My short account of the results of spirit levelling in Bengal accumulated between 1862 and 1930 and their interpretation are given in the Survey of India Geodetic Report (6 104–6) In such a report considerations of space preclude the inclusion of every corroborative detail which the full records of the work contain

Sir Sidney Burrard not quite rightly says that my theory rests on three levelling results Actually it rests on a group of levelling circuits all giving evidence in the same direction , but the results which he cites are certainly important The first of these does not rest on the single bench mark at the railway station If reference is made to pp 71 97 *loc cit* it will be seen that two bench marks a quarter of a mile apart, were picked up at Pirpainti and gave results agreeing within 0 05 ft Further the connexion with Pirpainti was made after results at Bhagalpur and Luckeesarai had indicated a rise of more than two feet , which the Pirpainti connexion confirmed The secondary' levelling of 1929 is almost of the same type as what was formerly (before the introduction of levelling of high precision) known as levelling of precision

The Benares result depends in part on Pirpainti now justified, and on modern levelling through the mountainous region of Hazaribagh In the case of a much more mountainous Himalayan circuit, I investigated the refraction anomaly and found it to be trivial a much more important error being due to the variation in length of the wooden levelling staves during the course of the day This tends to increase with the total amount of ups and downs of the line which in the case of the Hazaribagh line are not enough to justify rejection of results though nowadays we should employ invar staves in such a case

Careful consideration was given to the errors which might naturally be expected in all these levelling lines including those on which the Dinajpur result was based and the special difficulties of wide river crossings were not forgotten

The geographical evidence is sufficient to cause Sir Sidney to mistrust the levelling of 1862 because the workers were inexperienced and had primitive instruments and more modern work when it passes through mountains such as occur in Hazaribagh I cannot bring myself to discount all the spirit levelling in this way and prefer to judge it by its own internal and unbiased evidence not omitting to consider the systematic error as usually evaluated

The spirit levelling evidence is limited to the area of its observations and so gives only a partial picture This covers roughly the triangle Calcutta–Darjeeling–Benares So the contours of my chart (NATURE Feb 17 p 236) extend little into the area of Sir Sidney s sketch of the rivers of Bihar Most of this river area may have risen almost uniformly which would certainly be in keeping with my area of underloading Why then should extensive geographical changes be expected or their absence be regarded as in opposition to the results of much spirit levelling ?

In my opinion much of the so called systematic error in levelling must be due to secular changes of ground level operating during the progress of the lines forming a circuit On this account we are probably assessing the precision of spirit levelling below its true value

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Research in the Sea*

THE latest available issue of the *Journal of the Marine Biological Association* contains many valuable memoirs being records of research undertaken chiefly at the Plymouth Marine Laboratory but also at the Scottish Marine Station Millport the Port Erin Marine Station Isle of Man and the Dove Marine Laboratory Cullercoats Northumberland The whole is admirably planned and emphasises the fact that oceanography in its broadest sense is the object of all the work done in these laboratories that is to say the study of the sea and its contents both animate and inanimate and of all factors which influence these centring round the fish itself It is impossible nowadays to separate pure science from the practical side or to say that any matter connected with the sea is irrelevant to its study and we find these researches carried on in the marine laboratories of Great Britain tend more and more to fit into one another and show real progress in general knowledge of the interpretations of marine phenomena

A glance at the subject matter will show how varied are the contents but yet how well everything really hangs together Perhaps the most notable of the contributions is Mr E Ford's account of the herring investigations conducted at Plymouth during the years 1924–1933, which is a summary of his own work in connexion with the Plymouth herrings covering this period He shows how far we have now gone in elucidating herring problems—a considerable distance, for we now can predict fairly well the probable constituents of the main portion of the herring fishery some years ahead, although weather and other agents may always upset calculations The breeding of the herring is now becoming well understood where the eggs are deposited, where the newly hatched larvæ are to be found and those slightly older, their migrations out to sea in search of food and their spawning migrations inshore Intensive studies of bones show how temperature has a distinct influence on the number of vertebræ and therefore of size, and thus the problem of races may be interpreted, and the reading of the scales tells us the ages of the fishes and the year classes to which they belong, so that we may know what classes are likely to make up the fisheries of future years This full and valuable paper is indeed worth reading

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* *Journal of the Marine Biological Association* N S 19 No 1 August 1933 pp 1 286 (Plymouth The Association)

Mr G A Steven's account of the food of the shags and cormorants round the Cornish coast also appeals directly to the fishing industry Here a long standing error is corrected, showing that the shag, which is far commoner on the open coast than the cormorant, is innocent of the destruction of commercially important fishes, its main food being smaller fishes of little value and usually not consumed by man The cormorant, feeding much farther inland, certainly does considerable damage by preying on our edible fishes, especially flat fishes

Trematode parasites of fishes are dealt with by Mr E Idris Jones, and Miss D Atkins describes a very interesting new orthonectid in the bivalve mollusc *Heteranomia* showing quite new features

The shell fish industry is represented by an important paper on oysters by Prof J H Orton, following up his previous work on sex, showing the fate of unspawned ova and the change from male to female The results described here of years of experiment with oysters in cages prove definitely for the first time that male individuals of *Ostrea edulis*, our common commercial oyster, pass into the female condition in significant proportion within twelve months, and that greater proportions attain the female condition in two years

Information as to the food of fishes and of invertebrates is at all times desirable, and on this subject there are several papers dealing with the plankton, Mr F S Russell on the seasonal distribution of macroplankton, Miss O Jorgensen on the marine *Cladocera* of the Northumberland plankton, and three papers of great interest by Dr A G Nicholls and Miss S M Marshall on *Calanus finmarchicus* from the Clyde area In these last the copepod, which is of the greatest significance as fish food, especially of the herring, is dealt with in a masterly way, and its reproduction and seasonal distribution, its variation in size and its vertical and diurnal migrations are described Mr G N Spooner's experiments on the reaction of marine plankton to light are very suggestive and may lead to the elucidation of some of the difficult problems connected with migrations

From animal plankton we come to vegetable plankton, and find Mr H W Harvey's paper on the rate of diatom growth, showing how the neritic diatom *Nitzschia closterum*, taken from the pure cultures grown by Dr E J Allen continuously for many years, react to experimental conditions, and Mr F M Ghazzawi, on the littoral diatoms of the Liverpool and Port Erin shores, touches a section of those Algæ which has been too long neglected and is of considerable importance in the economy of the sea

In connexion with the long standing and classic Mendelian work on *Gammarus* by Mrs E W Sexton, which has been going on for many years in the Plymouth Laboratory, it is interesting to find that Mr Bassindale has discovered abnormal eyes in wild *Gammarus* in the Tay Estuary

The inorganic element is well to the fore, and in two papers Dr L H N Cooper continues his work on chemical constituents of biological importance in the English Channel and shows how winds influence the salt content in the sea, whilst Dr W R G Atkins and Dr H H Poole discuss the use of cuprous oxide and other rectifier photo-cells in submarine photometry, and Dr Atkins describes a method for rapid estimation of the copper content of sea water.

University and Educational Intelligence

A MATHEMATICAL Colloquium will be held in St Andrews on July 18–28, under the auspices of the Edinburgh Mathematical Society Courses of lectures will be given by Prof E A Milne (Oxford), Prof B M Wilson (Dundee), Prof H W Turnbull (St Andrews), and Mr W L Ferrar (Oxford) The local secretary is Dr D E Rutherford, United College, St Andrews

THE educational film has now an assured place as a teacher's tool The Central Information Bureau for Educational Films, established to further its employment, publishes a bulletin, *Film Progress*, in the December–January issue of which is announced the completion of a catalogue (price 3*s* 9*d*, post free, Central Information Bureau for Educational Films, 103 Kingsway, W C 2) of about two thousand films (35 mm, 16 mm and 9 5 mm) already made and approved by authoritative associations or individual experts on agriculture, engineering and industry, geography and travel, vocational guidance, and science, including hygiene, physics, chemistry, geology, physiology and psychology

WE have received from the University of Leeds a handsomely illustrated booklet presenting the salient features of its organisation, actual and projected, and an account of its chief courses of study It recalls the fact that the land and buildings of the University have been provided almost entirely as a result of private generosity, sometimes unsolicited and sometimes in response to public appeals such as that which has recently produced £430,000 Unshackled by commitments of imperfectly prescient founders of long ago, the University is taking shape in the disposition of its main buildings as an example of planning for maximum efficiency, the departments comprised in the faculties of arts, law, economics and commerce, science and technology being grouped around the new Brotherton library and within five minutes' walk of the medical and dental schools, which are adjacent to the General Infirmary Attention is directed to the fact that more than a quarter of the full time students are in halls of residence

Science News a Century Ago

Mary Somerville at the University of Cambridge

In the spring of 1834 Dr William Whewell sent an official invitation to Dr Somerville and his wife Mary Somerville the distinguished author of the Mechanism of the Heavens to visit the University of Cambridge for a week or so Apartments had been arranged for them in Trinity College Prof Adam Sedgwick the geologist was entrusted with the social arrangements and general itinerary In a letter to Dr Somerville dated April 1834 Sedgwick in characteristic vein says —

My dear Somerville your letter delighted us I have ordered dinner on Thursday at 6½ and shall have a small party to welcome you and Mrs Somerville On Tuesday you will I hope dine with Peacock, on Wednesday with Whewell on Thursday at the Observatory For Friday Dr Clarke our professor of anatomy puts in a claim For the other days of your visit ample employment A four poster bed (a thing utterly out of our regular monastic system) will rear its head for you, and Madame in the chambers immediately below my own and your handmaid may safely rest her bones in a small inner chamber Should Sheepshanks return we can stuff him into a lumber room of the Observatory but of this there is no fear as I have written to him on the subject and he has no immediate intention of returning You will of course drive to the great gate of Trinity College and my servant will be in waiting at the Porter s lodge to show you the way to your academic residence We have no cannons at Trinity College otherwise we would fire a salute on your entry we will however give you the warmest welcome we can (Personal Recollections of Mary Somerville by her daughter Martha Somerville (1873))

American Railroad Progress

The first American railroad to be constructed with the intention of using steam locomotion only was the South Carolina Railroad commenced in 1827 but the first to be opened was the Baltimore and Ohio Railroad a part of which was brought into service in 1830 Peter Cooper s *Tom Thumb* engine running for a short time With the adoption of British practice and the importation of English locomotives which were far better than the early American locomotives railroad projects created increased interest and by the spring of 1834 there were no fewer than thirty seven incorporated railroad companies in the State of New York alone having a total capital of nearly thirty million dollars As in England the construction of the permanent way presented many difficulties and when the Philadelphia and Columbia railroad was built three different systems were tried On one part of the line the rails were laid on continuous granite sills on another on stone blocks three feet apart and on another on continuous wooden sleepers The difficulty with flat iron rails was referred to in a letter by Mr A C Jones of Philadelphia written on April 15 1834 to the editor of the *Journal of the Franklin Institute* In this letter Mr Jones said that on the Little Schuylkill Railroad there were two locomotives plying, and during the course of the last season they ran off the track fourteen times Wooden roads he considered the only proper kind for locomotives but the trouble arose from the flat iron rails 2 in wide and ⅝ in thick being joined improperly Such plate rails were, however soon afterwards abandoned for the inverted T shaped rail originally introduced by Robert *Livingstone Stevens in 1830*

Audubon s Birds of America

The year 1834 saw John James Audubon the American ornithologist continue his visits to England to exhibit his bird paintings in order to raise subscriptions for the publication of his work on The Birds of America Early in March 1834 he left Charleston and passed north to Washington Baltimore and New York In a letter of April 6 to Miss Maria Martin Audubon wrote that he had collected £600 and had sent £500 to Mr Victor in bills of exchange to await them at London Audubon his wife and son John finally sailed from New York on April 16 1834 in the packet *North America* for Liverpool In a letter written the day before he sailed to Edward Harris acknowledging receipt of 400 dollars in advance for a copy of his book he wrote My drawings shipped from Charleston are safely in the hands of Victor at London I have been able to forward to him 650£ and I have 30 sovereigns to defray expenses from Liverpool to the Great Metropolis In 1824 poor J had dreams but how far was I then from believing that I should ever have succeeded as I have who will believe my story ? Only one or two besides yourself have an idea of what I have undergone but if God grants me life I shall publish that story and send you sheets thereof as they are struck by the printer

Audubon brought to England all the collections he had accumulated in three years travel in the United States and British possessions and the passage to Liverpool took him nineteen days On arriving at Liverpool Audubon renewed his friendship with the local naturalists though Roscoe founder of the Liverpool Botanic Gardens had died since his previous visit His stay was brief and he continued on to London arriving there on May 12

Marine Steam Engine Improvements

With very few exceptions all early steam vessels had engines fitted with jet condensers and used sea water in their boilers The principal pioneer of the marine surface condenser as used to day was Samuel Hall who was born at Basford Nottingham in 1781 and died in 1863 at Bow in East London Hall had been successful with patents for gassing lace and net and was fifty years of age when he turned his attention to the marine steam engine He took out several patents one of his most important being No 6556 of Feb 13 1834 for a combination of a circulating pump an air pump a tubular surface condenser and an evaporator Shortly after this on April 19 1834 the *Mechanics Magazine* noted that the well tried favourite of the public the *Prince Llewelyn* now plying twice a week betwixt the Menai Straits and Liverpool is the first packet that has been fitted out on Mr Samuel Hall s principle for the improvement of steam engines consisting of a superior method of condensing the steam and using fresh instead of salt water thereby creating a great saving in the boilers and at the same time consuming one third less of fuel In spite of the many advantages of Hall s improvements surface condensers were not used on a large scale until forty years later

Societies and Academies

LONDON

Physical Society, February 16 T SMITH (1) Integrals of products of experimentally determined magnitudes The integral of a product of quantities known only for discrete values of a variable is given correctly by the simple sum of the products for uniformly distributed values of the variable Nothing is gained by increasing the number of component products beyond the number of observed values of either factor (2) Condensed tables for colour computation It is sometimes sufficient in the spectrophotometry of coloured materials for the determination of their colour co ordinates on the C I F system to take measurements at intervals of 10 mμ instead of the standard interval of 5 mμ Special tables have been computed for use in these cases C E WYNN WILLIAMS A relay memory for a thyratron counter An automatic mechanism consisting of sixteen interconnected relays and capable of carrying out a complicated cycle of operations in correct sequence in less than half a second The apparatus is used in conjunction with a valve amplifier and an automatic thyratron counter for the analysis of α particle groups by means of a magnetic focusing method The relay mechanism arranges for alternate comparative counts of α particles to be made under two different sets of experimental conditions W G PENNEY A note on the twisting frequency in ethylene From the experimental value for the fundamental twisting frequency in ethylene the magnitude of a certain carbon carbon exchange integral J is determined as 0 72 ± 0 10 electron volts According to this result the energy needed to twist one of the CH_2 groups through an angle $\pi/2$ with respect to the other about the C C axis is 1 0 ± 0 2 This agrees well with the experimental value for the heat of activation of dimethyl maleate to dimethyl fumarate F C CONNELLY The instantaneous projection of thermionic valve characteristics Two mirror oscillographs are employed with axes at right angles one indicating the anode current and the other the grid potential A suitable alternating voltage of small amplitude from a 50 cycle supply is applied to the grid causing the characteristic to be traced out 50 times a second and persistence of vision causes the whole curve to be visible The instrument indicating current is a Sprenger oscillograph while the voltage controlled vibrator is a special instrument designed for the purpose

PARIS

Academy of Sciences, February 19 (*C R* 198 685–776) J COSTANTIN Cultures of the potato at high altitudes and in high latitudes Details of experiments on the growth of potatoes at the summit of the Pic du Midi at Skarsvaag in the north of Norway in the Alps and in the Andes R FOSSE P E THOMAS and P DE GRÆVE Allantoin possessing rotatory power Lævorotatory allantoin can be obtained by the action of allantoinase (from soya bean) on inactive allantoin J HAAG The calculation of mechanical or electrical oscillations MME HILDA GEIRINGER Applications of a new general method of theoretical statistics MICHEL PETROVITCH A general mode of representation of elliptic functions MLLE M CHARPENTIER Some properties of the curves of Birkhoff GEORGES KUREPA The linear continuum T VIOLA The theorem of identity for holomorph functions of several variables JULIUS WOLFF A property of the conformal representation of bands A MARTINOT LAGARDE A change of regime in the flow of air round a model of an aeroplane wing ARY J STERNFELD The trajectories allowing the approach to a central attracting body starting with a given Keplerian orbit J GÉHÉNIAU The Dirac equations of the second order L GOLDSTEIN A theory of quantification of matter MLLE M QUINTIN A method of determination of normal potentials RENÉ LUCAS The diffusion of light and molecular polymorphism A KASTLER The proportion of polarisation of the fluorescence of pure mercury vapour PIERRE DAURE Study of the circular polarisation of the Raman lines of pinene illuminated with circularly polarised light and observed longitudinally ALBERT PÉRARD The red line of cadmium is essentially reversible RENÉ AUDUBERT and MLLE GENEVIÈVE LEBRUN The influence of the intensity of the light on photovoltaic phenomena Further experiments in support of the theory that photovoltaic phenomena must be principally attributed to a photolysis of water under the action of the radiation MARCEL SERVIGNE A liposoluble compound of polonium Experiments on the solubility of polonium camphocarboxylate in oil and in organic solvents MARCUS FRANCIS and TCHENG DA TCHANG The value of the ratio of bifurcation of the actinium family with respect to the uranium radium family The number of atoms of protactinium disintegrated in unit time for 100 atoms of uranium I disintegrated in the same time has been redetermined using the tantalum method The result 4 per cent agrees with the value of Grosse obtained by the zirconium method HENRI LEFEBVRE and MAURICE VAN OVERBÈKE The chemical action of the condensed spark on mixtures of carbon monoxide and hydrogen If the tube containing the mixture of carbon monoxide and hydrogen communicates with a tube maintained at − 183° C the products consist mainly of carbon dioxide acetylene and water RENÉ WURMSER and J A DE LOUREIRO The reversibility of oxidoreduction systems derived from the glucides MLLE O HUN The cryoscopic study of the total hydration of the ions of nickel chloride E ROUYER The cryoscopic determination of the total hydration of the ions of barium chloride PAUL WOOG JEAN GIVAUDON and FERNAND DAYAN The variation of the thawing point (*fluage*) of mineral oils accompanying changes in their state E CANALS and P PEYROT The molecular diffusion of light in fluorescent liquids J COURNOT and F HILTBOLD The properties of German silver JEAN SAVARD The ionisation potentials and energies of formation of non polar molecules L ANDRIEUX and M DODERO The electrolysis of fused silicates and the preparation of silicon and silicides Description of experiments on the electrolysis of fused lithium silicate The products obtained were silicon lithium alloys containing crystallised silicon G GHEORGHIU The isomerisation of some 2 2 disubstituted derivatives of indanedione L BARRABÉ The Tertiary formation which has covered the eastern part of Guadeloupe JACQUES DE LAPPARENT The Samos emery deposits J CUVILLIER The distribution and stratigraphic value of *Nummulites lævigatus* in the Egyptian Eocene HUBERT GARRIGUE The slightly penetrating radiation at the Pic du Midi A GUILLIERMOND The nature and meaning of Golgi s apparatus ALBERT F BLAKESLEE and MME SOPHIA SATINA Do plants differ from animals by the lethal gametes ? PH l HÉRITIER The comparative demographic study of four strains of *Drosophila melanogaster* ÉMILE F TERROINE and MLLE GILBERTE MOUROT The real value of endogenous purine metabolism

CRACOW

Polish Academy of Science and Letters, November 6 F LEJA The existence of a domain of convergence of series of homogeneous polynomials TAD BANACHIEWICZ A problem of geophysics The author discusses the problem of the determination of the altitude H at the zenith of the point lighted by the grazing rays of the sun An approximate formula is given $H = H_0(1 + K)$ where H_0 is the altitude calculated for a spherical earth and K is a small quantity for which tables are given M CENTNERSZWER and M BLUMENTHAL The formation and dissociation of the alkaline peroxides The authors show that the dissociation of the known peroxides of the alkali metals is a reversible phenomenon Certain peroxides dissociate in the solid state below their melting points J KOZAK and F PAZDOR The photokinetics of reactions of bromination (5) The bromination of the alkyl derivatives of naphthalene in light The velocity of bromination of these compounds varies with the wave length of the incident and absorbed light There is a difference between the substitution and addition reactions B PAWLOWSKI Studies on the delphiniums of central Europe belonging to the section *Elatopsis* B SZAFRAN The flora of the diluvial Muscineæ of Starunia T KORMOS Fragments of bone of small vertebrates found in the diluvial clay of Starunia F LANGERSDORFF The Diptera of the diluvial layers of Starunia F ZEUNER The Orthoptera of the diluvial layers of Starunia Z GRODZINSKI The development and comparative anatomy of the axial blood vessels in the anterior extremities of mammals J ZAOWILICHOWSKI The innervation of the sensorial organs of the wings of the bee (*Apis mellifica*)

LENINGRAD

Academy of Sciences (*C R* N S , No 3, 1933) B SEGAL A general theorem expressing some properties of an arithmetical function D EROPKIN The problem of the existence of oxygen in the atmosphere of Mars Theoretical suggestions for the solution of this problem by obtaining evidence of the presence or absence of ozone, which strongly influences the ultra violet region of the spectrum even if present in extremely small quantities G RUMER The eigenfunctions of atoms in an impulse space A proof of Balmer s formula is offered which is considered simpler than the usual one M LEVITSKAYA and V DLUGAC A selenium compound with thermoelectric power An alloy containing 35 per cent of selenium and 65 per cent of copper prepared at a temperature above 1 000° possessed qualities making it eminently suitable for use in thermocouples O VEHR and M M ROMANOV Some alloys resistant in phosphoric acid The chromium steel containing carbon, 0 48 per cent silicon 2 74 per cent and chromium, 38 per cent, proved to be resistant in 80 per cent phosphoric acid at 135° Very resistant also is an aluminium bronze containing about 0 5 per cent of chromium, as well as a bronze containing 9 46 per cent of aluminium, 0 37 of chromium, 0 26 of iron and copper A RUSHCHINSKIJ The possibilities of obtaining by synthesis valuable aromatic aldehydes from new sources The methods are discussed for obtaining vanilline burbonal and heliotropine by introducing the aldehydogenous group and from phthallic anhydride P IVANNIKOV A FROST and M SCHAPIRO Influence of heating on the catalytic activity and other qualities of zinc oxide The greatest catalytic activity is exhibited when the catalyst is heated to 230° The temperature of heating does not affect the crystal lattice of the zinc oxide A considerable growth of crystals begins at temperatures above 900° M K TCHAILAKHIAN The formation and decomposition of chlorophyll in the leaves of winter and spring cereals The additive effect of darkness upon the decomposition of chlorophyll permits an independent utilisation of the quantity of chlorophyll as a method of distinguishing spring forms from winter forms V NOVIKOV and E HERBER The inducing of rubber formation in plants by ultra violet rays The seedling of the tau sagiz rubber plant from seeds exposed to irradiation of a quartz mercury lamp showed a great increase in activity of the catalase Plants grown from irradiated seed produced a greater quantity of rubber than the controls B B POLYNOV The types of erosion and their distribution according to the geomorphological conditions A general classification is offered of the forms of rock erosion and their genetic connexion is briefly outlined

ROME

Royal National Academy of the Lincei Communications received during the vacation 1933 A BEMPORAD Stellar currents about R A $14^h + 52°$ Decl Q MAJORANA New investigations on metallic photo resistance Results obtained with deposits of aluminium and of sodium are described M CAMIS Endopleuric pressure and atmospheric pressure Experiments with sheep and rabbits confirm the fact that lowering of the endopleuric pressure accompanies diminution in the atmospheric pressure G SCORZA DRAGONI Multiplication of series which converge conditionally (1) U BROGGI Certain problems of the summation of divergent series B DE FINETTI The law of large numbers in the case of equivalent aleatory numbers MARIA CIBRARIO The polynomials of Bernoulli and Euler G ARRIGHI The statics of floating and the dynamics of buoyancy LUISA PELOSI Parallelism defined by angular variations M MAGGINI The influence of colour on the photoelectric measurements of stars Various examples considered show that in some cases variations in the colour of stars may be such as to mask those of the brightness, and that in addition to stars varying in relation to their luminous intensity, there may be some which vary only as regards colour G MEZZADROLI and A AMATI Action of certain alkaloids on invertase The activity of invertase is diminished greatly by the presence of small proportions of strychnine nitrate, the effects of caffeine or of quinine sulphate being far less marked N MÉTALNIKOFF Experiments on the multiplication of infusoria under the action of oscillating circuits The multiplication of *Paramecium caudatum* is accelerated by oscillating circuits, those of smaller diameter exerting a more pronounced influence than larger ones FAUSTA BERTOLINI

Teeth of Selachii in relation to nutrition Different species of Selachii show four distinct types of teeth which correspond with four different types of nutriment **MARGHERITA OLLINO** Experimental investigations on the metamorphosis of anuric amphibia Transplanting experiments in relation to larval stages and to hormonal (thyroid) conditions **EUFROSINE RUZZA** Investigations on the development of the pronephros of amphibia **R NOVELLO** Observations on the chloroplasts of the palm **G MORUZZI** The existence of transneuronic degenerations

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, April 16

ROYAL SOCIETY OF ARTS at 8—Prof J G Gray Gyroscopes (Thomas Gray Lecture Succeeding lectures on April 23 and 30)

ROYAL GEOGRAPHICAL SOCIETY at 8 30—Prof E de Martonne The Andes of the North West Argentine

Tuesday, April 17

EUGENICS SOCIETY at 5 15—(in the rooms of the Linnean Society Burlington House Piccadilly W 1)—A Symposium on Birth Control Speakers Representatives of the National Birth Control Association and the Society for the Provision of Birth Control Clinics *

Wednesday, April 18

ROYAL SOCIETY OF ARTS at 8—W R Gordon The Utilisation of Coal

SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS at 8—(at the Essex Hall Essex Street Strand W C)—Dr Marie Stopes Lord Dawson s Contraceptives Bill what has happened and what must still be done

Thursday, April 19

CHEMICAL SOCIETY at 8—(at the Royal Institution Albemarle Street London W 1)—The Right Hon Lord Rutherford The Periodic Law of Mendeléeff and its Interpretation (lecture to commemorate the centenary of Mendeléeff)

Friday, April 20

ROYAL INSTITUTION at 9—Prof P M S Blackett Cosmic Radiation

ELECTRICAL ASSOCIATION FOR WOMEN April 19–20 Ninth annual conference to be held in London

Official Publications Received

GREAT BRITAIN AND IRELAND

An Index to Acts of Parliament and Statutory Rules and Orders affecting the Chemical Industry (Published for the Association of British Chemical Manufacturers.) Supplement No 3 Pp 6 (Cambridge W Heffer and Sons Ltd) 6d

Armstrong College Dove Marine Laboratory Cullercoats Northumberland *Report for the Year ending July 31st 1933* Pp 53 (Cullercoats) 5s

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1552 (T 3344 3367 3390) Methods of Visualising Air Flow By K W Clark Pp 10+18 plates 1s net No 1563 (T 3040 and a) Abstract—A Survey of the Air Currents in the Bay of Gibraltar in 1929–30 By J H Field and Dr R Warden Pp 3+1 plate 6d net (London H M Stationery Office)

Oilscoil Na h Eireann (The National University of Ireland) Calendar for the Year 1933 Pp viii+290+622+281 (Dublin)

Report of the Marlborough College Natural History Society for the Year ending Christmas, 1933 No 82 Pp 120+6 plates (Marlborough) 3s, to Non Members 5s

Scottish Marine Biological Association Annual Report 1932 33 Pp 23 (Glasgow)

OTHER COUNTRIES

Memoirs of the Faculty of Science Taihoku Imperial University Vol 10 No 2 Mathematics No 7 Über Flächen und Kurven 6 Eilinien und Eiflächen Beiträge zur Geometrie der Kreise und Kugeln, 8 Von Sôji Matsumura Pp 21 70 (Tokyo Maruzen Co Ltd)

U S Department of the Interior Geological Survey Bulletin 844–C The Susiota Pass District, Upper Copper River Region, Alaska By Fred H Moffit (Mineral Resources of Alaska 1931) Pp ii+137 162+plate 2 15 cents Bulletin 844–D Mineral Deposits of the Rampart and Hot Springs Districts Alaska by J B Mertie Jr Placer Concentrates of the Rampart and Hot Springs Districts by A E Waters Jr (Mineral Resources of Alaska, 1931) Pp iv+163–246+plates 3–5 10 cents Bulletin 857 A Mineral Industry of Alaska in 1932 By Philip S Smith (Mineral Resources of Alaska 1932) Pp ii+91 10 cents Bulletin 857 B Past Placer Gold Production from Alaska By Philip S Smith (Mineral Resources of Alaska 1932) Pp 93 98 5 cents Circular 6 Mineral Water Supply of the Mineral Wells Area, Texas By Samuel F Turner Pp ii+9+1 plate Professional Paper 175 Shorter Contributions to General Geology 1932 33 Contents and Index Pp iv+115–117 (Washington D C Government Printing Office)

Zoologica Scientific Contributions of the New York Zoological Society Vol 16, No 4 Deep Sea Fishes of the Bermuda Oceanographic Expeditions—Family Idiacanthidæ By William Beebe Pp 149–241 (New York City)

The University of Lucknow Abstracts of Publications by Members of the University (Department of Botany) 1928 1932 Pp 41–89 (Lucknow)

Transactions of the Astronomical Observatory of Yale University Vol 10 Catalogue of the Positions and Proper Motions of 8703 Stars Re-observation by Photography of the Astronomische Gesellschaft Zone between Declinations +20 and +25 reduced to 1875) without applying Proper Motions By Frank Schlesinger Ida Barney and Carolyn Gesler together with Photographic Magnitudes determined by means of the Thermoelectric Photometer by Jan Schilt Pp iii+5+176 (New Haven Conn)

Publications of the Observatory of the University of Michigan Vol 5 No 12 A Study of Class B Stellar Spectra By Roy K Marshall Pp 137 167+2 plates (Ann Arbor Mich)

Publications de l Observatoire astronomique de l Université de Belgrade Tome 6 Annuaire pour l an 1934 Rédigé par V V Michkovitch Pp 112 (Beograd)

Publikationer fra det Danske Meteorologiske Institut Aarbøger Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1933 Pp 17+5 maps (København G E C Gad)

Journal of the Indian Institute of Science Vol 16A, Part 11 Studies in Bridge Formation, Part 3 The Influence of the Methyl and Carbethoxy Groups in the Internal Dehydration of *gem* Disubstituted Dihydroresorcinol Esters Part 4 Tautomerism in *iso*-Phorone By P S Mavuranathan Pp 113 127 1 rupee Vol 16A, Part 12 Synthesis of Proteins in Plants Part 1 Conversion of Nitrates into Protein in *Helianthus annus* Linn By K S Varadachar Pp 129–138 12 annas Vol 16A, Part 13 Contributions to the Study of Spike Disease of Sandal (*Santalum album* Linn), Part 15 The Rôle of Plant Acids in Health and Disease By A V Varadaraja Iyengar Pp 139–152 1 rupee Vol 17A, Part 1 The Thermal Dissociation of Cadmium Carbonate By P Y Narayana and H E Watson Pp 6 12 annas Vol 17A Part 2 Studies in Indian Essential Oils 5 Essential Oil from the Rhizomes of *Curcuma longa* Linn 6 Essential Oil from the Rhizomes of *Acorus calamus*, Linn By N C Kelkar and B Sanjiva Rao Pp 7 31 1 8 rupees (Bangalore)

Fiskeridirektoratets Skrifter Serie Havundersøkelser Report on Norwegian Fishery and Marine Investigations Vol 4 No 8 Some Observations on Cod in Northern Waters—Preliminary Report By Thor Iversen Pp 35 (Bergen A S John Griegs Boktrykkeri)

Dominion of Canada Sixteenth Annual Report of the National Research Council, *containing the Report of the President* and Financial Statement 1932 1933 Pp 113 (Ottawa.)

Carnegie Institution of Washington Publication No 440 Contributions to Palæontology—Papers concerning the Palæontology of California Arizona and Idaho Pp iii+136+28 plates (Washington D C Carnegie Institution)

U S Department of Agriculture Circular No 305 The Boxwood Leaf Miner and its Control By William Middleton and Floyd F Smith Pp 8 5 cents Technical Bulletin No 388 The Southwestern Corn Borer By E G Davis J R Horton, C H Gable E V Walter and R A Blanchard, with Technical Descriptions by Carl Heinrich Pp 62 10 cents (Washington D C Government Printing Office)

U S Department of the Interior Geological Survey Bulletin 846–C The Climax Molybdenum Deposit By B S Butler and J W Vanderwilt with a Section on History Production Metallurgy and Development by Charles W Henderson (Contributions to Economic Geology 1933 Part 1) Pp iv+195–237+plates 23 38 50 cents Bulletin 858 Bibliography of North American Geology, 1931 and 1932 By John M Nickles Pp ii+300 25 cents Circular 5 Geology of the North and South McCallum Anticlines Jackson County Colorado with Special Reference to Petroleum and Carbon Dioxide By J C Miller Pp 27+2 plates (Washington D C Government Printing Office)

Annual Report of the Imperial Council of Agricultural Research for the Year 1932 33 Pp iii+61 (Delhi Manager of Publications) 6 annas 8d

CATALOGUES

The B–S Pocket Refractometer Pp 4 (London Bellingham and Stanley, Ltd)

Eastman Organic Chemicals (List No 25) Pp 112 (Rochester N Y Eastman Kodak Co)

Medicinal Glucose (Anhydrous) Dextrose B P Pp 16 Gonococcus Vaccines. Pp 16 (Nottingham Boots Pure Drug Co Ltd.)

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Professional Organisations and Modern Industry

IN a survey of modern industry from any point of view four tendencies are easily discerned as characteristic of conditions to day in contrast with those of a couple of decades ago The first of these tendencies is the growing scale of industrial enterprise and particularly the growth in size of the industrial unit It is true that the number of small firms in British industry remains surprisingly large but the growth in size of the leading firms is unmistakable particularly in chemical industry Although chemists are employed in such an immense range of industries those employed by really large firms represent a very considerable proportion of the numbers of the profession who are engaged in industry

The second tendency is the growing complexity of modern industry Not only is competition, whether in national or international markets generally more severe but also the complexity of manufacturing problems has increased The range of products produced by an individual firm will frequently be found to have multiplied several fold and the reactions involved in the displacement of old by new products frequently present those responsible for the direction of industry with some of their most difficult problems

Both the growing scale of modern industry and the increasing complexity of its operations have made the wise direction of industrial enterprise one of the outstanding needs of our time The importance of technical factors in administration has increased at the very time when the consequences of a mistake in administration have also increased their power Society can no longer afford to allow large scale enterprise to be directed by the *entrepreneur* and is already beginning to realise that our industrial prosperity largely depends on the direction of industry being based so far as possible on definitely ascertained facts and not on experience

Closer consideration of this question of scientific management brings to light the third factor which characterises industry to day The increase in the average size of the industrial unit has been accompanied by a growth in the importance of the duties which fall to those occupying the higher salaried positions There is already a pronounced tendency for salaried business administrators to be professional men and for those at the head of large concerns and bearing the responsibility of ultimate decisions to be drawn either from professional men or from those who, like the accountants, are tending to come under professional influence There is less and less place in positions which carry powers of ultimate direction for men lacking professional technique and that kind of training and experience out of which a technique is now being evolved It is probably true, as Prof Carr Saunders has suggested, that under a system of large scale commercial and industrial organisation, all those who occupy the important positions will come within professional associations or at least under professional influences It is certain that the incompatibility of profit making with professionalism is no longer an obstacle to the spread of professionalism through industry

Closely related to this is a fourth factor—the extent to which the spirit of service is taking hold of industry This may be seen on one hand in the way in which co operation between the manu facturer of a product and the users is facilitating the development of products giving better service It is equally seen in the growing degree to which men of high personal character and cultural vision are finding in management a sphere of social service One of the fundamental characteristics of the professional outlook is its emphasis on service , and to the extent to which the control of industry passes into professional hands we may expect to see the spirit of service increasingly influence its conduct Apart from this, there is a marked and growing tendency in public opinion to judge large scale industry by the fidelity with which it serves the public weal rather than by its success in amassing huge profits

These four tendencies are of fundamental importance in considering the position of pro fessional organisations in relation to industry When in the early years of the British Association of Chemists there were formed within that organ isation groups of chemists engaged in specific industries, such as the Guild of Textile Chemists, or the Guild of Dyestuffs Chemists, it was thought that one of their functions might have been to assist in the growth of industrial co operation, either in such matters as industrial safety or in representations to the Government on matters of public policy During the last ten years, apart from the growth in size of firms in chemical industry, such associations as the Association of British Chemical Manufacturers or the Federation of British Industries have grown up, which are giving regular attention to such matters and through which corporate representations to Government are naturally and readily made by accredited representatives of industry Such associations obviously already have within them the germ of the 'councils of industry' advocated by Mr Harold Macmillan and others as a basis for an industrial parliament

The function of professional organisation in industry from this point of view must obviously be somewhat narrower To admit this is not to deny the value and imperative necessity of defence associations To be effective, representations to the State from a body of industrial professional workers must obviously be confined to matters of definite professional importance, such as conditions of employment, training and so on In this field, however, very useful work remains to be done The increase in the size of the industrial unit, so far as the chemist is concerned, has probably tended to increase his security, conditions of service and remuneration The experience of the British Association of Chemists, however, indicates that there is still a great deal of work to be done in protecting the interests of chemists employed in less organised industries and by smaller firms Probably the risk of undercutting in the profession of chemistry is less to-day than in the past, but it is to the credit of the profession that such a relatively large proportion of those holding senior or secure positions in industrial work are members of their professional defence association

Education is a matter in which professional associations have always been more or less interested Under modern industrial conditions their active concern is more than ever required The task of planning educational policy, not merely qualitatively but also quantitatively in relation to the recruitment capacity of industry, can scarcely be solved without co operation from the professional organisations, worthy of the best efforts of even the Institute of Chemistry's fine record

One effect of the increase in size of the industrial unit has been to diminish the mobility of the professional workers in industry This has some bearing on both professional and industrial efficiency It increases the risk of grooviness and militates against the influx of personnel, less familiar indeed with the detail or technique of an industry, but more receptive of new ideas and better able to exercise a detached critical view This is a matter of sufficient importance to research to merit the attention of professional associations.

It should not be impossible to suggest some system of exchange or interchange which would be of immense value to all concerned

The question of industrial safety itself is by no means outside the legitimate sphere of work of professional associations In the main it is true their most effective work will be done through the maintenance of a high spirit of public service among their members, but recent events suggest that on occasion something more may be required It is at least open to discussion whether when a firm, for good or bad reasons, declines to accept the protection of the patent law and operates a secret process, the liability to disclose the full details in the event of any accident or loss of health or life should not be one of the risks incurred It is inconsistent with the ideal of a profession to permit the concealment of information which may have a vital bearing in health and safety in other quarters of industry

The second and third characteristics of modern industry, its growing complexity and the growth in importance of the duties which fall to the lot of the professional worker occupying the higher positions in industry, more than balance, however, any loss of influence of his professional organisations Professional influence in industry is now, and to an increasing extent will be, exerted largely through the individual members of the profession occupying important posts in which professional ideals influence industrial decisions and policy This factor alone makes it essential that professional organisations themselves should corporately not only be alive to these possibilities but also animated by the very highest professional traditions Professional workers, individually or collectively, are interested in doing a job well, in industrial and professional efficiency, only professional association can secure them the independence in which the finest professional ideals flourish and are practised

There is probably nothing more needed to heal the ills of our industrial and social world to-day, whether regarded from a national or from an international point of view, than the spread of just that spirit of service which is the quintessence of the professional spirit The extent to which that spirit has already found a foothold in industry, and to which it is already expected of industry, should embolden all scientific workers to address themselves individually and collectively to the task of relating knowledge and power in the service of society and industry

About Birds

(1) *Northward Ho!—for Birds from Wild Moorlands of England to Moorlands and Marshes of Scotland and Shetland, Öland and Lapland* By Ralph Chislett Pp xvi+188+44 plates (London *Country Life*, Ltd, 1933) 15*s* net

(2) *Birds from the Hide* Described and photographed by Ian M Thomson Pp xi+108+63 plates (London A and C Black Ltd, 1933) 12*s* 6*d* net

(3) *Evolution of Habit in Birds* By Edmund Selous Pp 296 (London Constable and Co, Ltd 1933) 10*s* net

(4) *Monographie des mésanges d'Europe* Par Marcel Legendre (Encyclopédie ornithologique, Vol 6) Pp 124+5 plates (Paris Paul Lechevalier et fils 1932) 36 francs

(5) *Australian Finches in Bush and Aviary* By Neville W Cayley Pp xix+256+21 plates (Sydney Angus and Robertson, Ltd, London Australian Book Co, 1932) 12*s* 6*d* net

(6) *The Nidification of Birds of the Indian Empire* By E C Stuart Baker Vol 2 *Turdidæ—Sturnidæ* Pp vii+564+6 plates (London Taylor and Francis, 1933) 30*s*

THERE is no branch of zoological science which offers so wide an appeal to human interests and so many avenues for the acquisition of new knowledge as the study of birds, and so it is with books about birds At one end of the scale are the systematic, cataloguing, dry tomes devised for the use of the specialist and no other—matter without much life, at the opposite end are those volumes which place all their eggs in one basket, the photographs meant to catch the eye and the pence of a Nature loving public—life without much matter

It is very noticeable that during recent years a change has been coming over both extremes Perhaps the stress of competition of numberless bird books, perhaps the demands of the reading public for more intelligent guidance, perhaps the re-awakening of a new interest in natural history, have one or all helped to raise the standard of the modern bird book In any event, it is seldom nowadays that, on one hand, the systematic treatise or regional fauna does not allot a large proportion of its space to the habits of birds, and, on the other, that the one-time picture book does not contain observations upon the objects of its photographs which are of real scientific value So the two extremes tend to approach each other on the common ground of natural history, and the science of bird lore gains by the change in mood

From a long series of books about birds received at the office of NATURE, we have made a selection of examples illustrating the most outstanding types of bird books, and each is excellent of its kind

(1) Northward Ho!" belongs to the new type of picture book, that is to say its photographs are of first quality, and its text is well written, readable and observant Its specialty is that it avoids the commoner species and in Scotland makes for such as the crested tit, greenshank, red and black throated divers, great and arctic skuas, whimbrel, and in Scandinavia for such as the turnstone, fieldfare, redwing, blue throat, wood sandpiper, jack snipe—most of them familiar enough to us in their winter garb, but to most of us unknown in their breeding haunts

(2) Ian M Thomson has found the greater part of his quarry in Shetland and on the Norfolk Broads The plates, unusual in form since the picture fills the page to the edge, are the most striking bird photographs the reviewer has seen The text is relatively short, but it is good, some interesting observations, picked at random from many, are the carrying of chicks in its beak by a water rail, the contrast between the defence of a young bittern which strikes with its bill, and of a young Montagu's harrier which strikes with its claws the action of the latter bird and of a water rail, both of which played with extraneous objects while brooding In the description of Plate 15, 'beak should be back', as in the text

(3) Mr Edmund Selous, whose death we regret to see announced, has produced quite a different type of bird book a serious effort to elucidate the evolution of habit by the interpretation of laborious observations made in the field Whatever habit he touches upon, Mr Selous deals with it suggestively the replacement of the fight in earnest by make-believe 'scrapping', the origin of simple nests like the lapwing's through movements associated with sex impulses, and so to more complicated nests, the beginning of courtship displays in sex posturing, the swallowing of the fæces of the young in the nest, as a possible addition to nutriment, the regular and extensive storing of acorns by Californian woodpeckers as a product of the simple habit of placing spruce cones in a bark crevice for convenience of pecking The author considers that the territorial proprietorship of birds is not 'consciously real", but he is in error in assuming that "territory" begins with the nest, and may not be associated with feeding, for American observations suggest the presence of winter feeding territories in some species Too much space is wasted on ill judged attacks against other scientific workers, and the pleasure of reading is destroyed by the cumbersome and involved style of expression

(4) This systematic account of the tits of Europe describes 15 species and 80 different races, but it is more than a descriptive catalogue, for it tells much about distribution and about habits, especially of nesting Where the opportunity was so good we should have liked to have seen more attempt made at mapping the ranges and analysing the relationships between the numerous geographical races

(5) For nearly a century and a half, the brilliantly coloured weaver finches of Australia have been kept in captivity, and many species have become quite domesticated The bird lover, whether he loves birds in cages, or prefers simply knowledge about birds, will find this a compendium of almost everything that is known about the natural habits and cage breeding of, as the coloured plates show, perhaps the most variously beautiful of cage birds

(6) Mr Stuart Baker continues his valuable accounts of Indian birds in a second volume upon nesting, practically a supplement to the Fauna of India series The nidification of 403 species and races belonging to some of the most familiar families is described Of 62 forms nothing of the nesting habits has been recorded, and often the descriptions are simply of the completed nest and its clutch of eggs, so that much has still to be learned about nest building, incubation, feeding and growth of the young, and so on If this work encourages observation of nesting habits at the expense of egg collecting, it will add to its great value to science In one of the most interesting nests in the world, and one of the most common in India, that of the tailor bird, the author states that the way in which the bird knots the thread with which it sews together the edges of a leaf or leaves, is unknown, and what possibilities of observational results are suggested by the record of peculiar and identical clutches of the Burmese race, obtained from the same creeper upon the porch of a cottage at an interval of eighteen years! Does it mean long life, or detailed hereditary transmission of egg characters? J R

Egyptian Astronomy

L'Astronomie égyptienne depuis les temps les plus reculés jusqu'à la fin de l'époque Alexandrine. Par E.-M. Antoniadi. Pp. xi+157+7 plates. (Paris: Gauthier-Villars et Cie, 1934.) 40 francs.

THE author of this work explains in his preface that, in view of the non-existence up to the present of any book treating of the different branches of the ancient Egyptian astronomy in detail, his object is to make good the deficiency. A special feature is an attempt to give the whole of the evidence on the subject which is to be found in Greek writers; to this end M. Antoniadi has copied and translated all the most important passages from those authors that he has been able to find in the Bibliothèque Nationale at Paris. Accordingly, we are given multitudes of passages translated from Herodotus, Plato, Aristotle, Ptolemy, Strabo, Diodorus Siculus, Lucian, Dion Cassius, Diogenes Laërtius, Hippolytus, Clement of Alexandria, Eusebius, the Emperor Julian, Porphyry, Simplicius, Proclus, Horapollon, Hermes Trismegistus, Stobaeus, to say nothing of Latin authors, Cicero, Pliny, Seneca, Macrobius and Censorinus.

There are seven chapters. The first consists of generalities'—the beginnings of the ancient Egyptian astronomy, presumed to have come originally from Ethiopia, the Egyptian priest-astronomers, the temples as observatories, with a digression on Egyptian mathematics (arithmetic, algebra and geometry), after which come some references to astrology and an account of various astronomical appliances known to have been in use in Egypt (the gnomon, sundials, waterclocks, graduated circles, meridian instruments, and so on). The second chapter begins with the relations which the Greek philosophers who visited Egypt (Solon, Thales, Pythagoras, Œnopides, Democritus, Plato and Eudoxus) had with the Egyptian priests and what they may be presumed to have learnt from them. After this a short sketch is given of the great discoveries in astronomy due to the Greeks themselves, including the deposition by the Pythagoreans of the earth from its assumed place in the centre of the universe, and the anticipation of the Copernican hypothesis, partly by Heraclides of Pontus so far as the axial rotation of the earth and the revolution of the planets Mercury and Venus about the sun are concerned, and completely by Aristarchus of Samos.

The statement on pages 28 and 29 of the debt of the Greeks to the Egyptians will no doubt be found by most experts to be decidedly exaggerated. It is well known how ready the doxographers and other Greek writers were to attribute to the Egyptians the invention of every sort of thing; and M. Antoniadi seems to take their testimony at its face value, sometimes even going further, as when, from a passage of Seneca to the effect that "The courses of the five planets were not determined. Eudoxus was the first to bring this theory from Egypt to Greece", he concludes that the reference is to the theory of epicycles, and that the Greeks owed this to Egypt. Those conversant with the limitations of Egyptian geometry as it appears in the surviving documents will not be likely to credit the Egyptians' capacity to deal with a theory like that of epicycles; rather it required for its discovery a genius such as that of Apollonius of Perga, the 'great geometer'; moreover, Eudoxus is not connected by any authority with the hypothesis of epicycles.

The same chapter has, however, an interesting suggestion about the Pythagoreans' non-geocentric system in which the earth, with the sun, the moon, and the five planets, revolved in circles round the "central fire", namely, that the 'central fire" was really the sun all the time, but that Philolaus felt constrained to resort to camouflage for fear of a fate such as very nearly overtook Anaxagoras for declaring that the sun was a red hot stone. M. Antoniadi (who has also developed his suggestion in some separate papers) relies, first, on a comparison of the descriptions by Simplicius, Stobaeus and others of the "central fire" of the Pythagoreans as containing the creative and governing principle in the universe, with passages of Plato, Aristotle, Cleomedes and others speaking of the sun in very similar terms; secondly, on the odd tradition that Philolaus said that there were *two* suns, the sun which we see being a sort of mirror receiving and concentrating the reflection of the "fire in the universe" and transmitting it to us, this statement again being held to be part of Philolaus' deliberate camouflage disguising his real meaning.

The end of the chapter is on Copernicus, and maintains that Copernicus owed far more to the Greeks than he would admit; the author quotes a score of passages from Copernicus, whom he likes to call "the Canon of Frauenburg", side by side with as many closely similar passages from Greek authors (Plato, Aristotle, Ptolemy, Cleomedes, Plutarch and Aëtius), suggesting that

"Le chanoine de Frauenburg oubliait bien souvent la source de son inspiration"

To return to Egyptian astronomy Chap iii is on the Egyptians' astronomical divinities and their ideas on the universe, Chap iv on the Egyptian constellations, their names and their situations on the circular star map from the Temple at Denderah now in the Louvre (as early as the second millennium B C the Egyptians knew at least forty three constellations) Chap v is on the sun, moon and planets (the Egyptians had of course distinguished the zodiac as the circle in which they move), with their names and respective representations, chap vi is on the earth and the Egyptian calendar (the Egyptians had arrived at a year of 365¼ days) The final chapter (chap vii) is on the astronomy of the great pyramids It consists of forty pages and gives a mass of details about them, their dimensions, their exact orientation and their supposed astronomical significance, with special emphasis on the sloping entrance passages which, being almost exactly in the plane of the meridian, were adapted to serve as "colossal meridian instruments, by far the largest ever constructed', in the observation of the circumpolar stars

The attraction of the book is much enhanced by the highly interesting plates and illustrations

T L H

A Panorama of Physics

The Development of Physical Thought a Survey Course of Modern Physics By Prof Leonard B Loeb and Prof Arthur S Adams Pp xv+648 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1933) 23*s* net

WITH the increasing complexity and development of science, the tendency becomes more evident for textbooks to appear, not only on the different sub-divisions of any particular branch of science, but also on each of the various aspects and further sub-divisions of these branches The number of works essaying to give a historical survey of physics as a whole and correlating the various sections, with due consideration of the philosophical basis, being distinctly limited, one approaches the present volume with more than ordinary interest, even though it was intended to meet the needs of a certain type of college course, rather than those of the general reader

The authors have attempted to compile a general fifteen weeks' course open to all students of arts and science irrespective of previous exposure to 'high school' physics, and comprehensible to a majority having only an elementary knowledge of mathematics The authors further state that it was therefore decided to "organise the subject in terms of the development of human ideas and concepts of the physical world", to give the manner of their evolution into modern physical science, and "at no place to introduce equations, laws, or phenomena without establishing their origin and their relation to other portions of the subject", the latter being "in every case shown to be the result of a controlled experiment or observation, or else a relation derived from such facts" It is not to be wondered at that the task is admitted to have proved exceedingly difficult, and one marvels at the range of matter covered in a text which copes with such extremes as giving (in a footnote) an explanation of the sine of an angle and, later, the Lorentz transformation formulæ, the Planck equation and the Einstein specific heat expression, or expounding why the formula of water is H_2O and not HO and giving, seven pages farther on, the Wöhler synthesis of urea, and in due course a detailed table of the extra nuclear electronic configurations

Every imaginable topic seems to be included from the phlogiston theory to the Heisenberg uncertainty principle The theme of historical development is adhered to throughout, while in the whole treatment mathematics is subsidiary and assumes little more than a knowledge of elementary algebra, although in one or two places the language of the calculus is introduced without any adequate explanation

The book opens with a historical survey of fifty pages dealing with science and philosophy under the Greeks and Romans, as well as much general history covering scholasticism, feudalism and the Church The foundation and work of the Royal Society receive due consideration

The first of the five main divisions of the book covers mechanics from the inclined plane to the theory of relativity, in the second part, heat and structure of matter, we go from thermometers and elementary heat to the laws of thermodynamics, entropy (which is vaguely discussed, but not defined), following which the rise of chemistry, gases, mean free path, Brownian movement, Van der Waals' equation, atomic field forces and quantum theory pass kaleidoscopically before the reader The next section, devoted to electricity and magnetism, covers Maxwell's laws and the magneton, and is succeeded by light, where, unlike in the case of the other subjects, elementary matter is omitted, but which in twenty-seven pages manages to range from Newton's spectrum, over the wave and corpuscular theories, to the ether, the interferometer and the Michelson-Morley experiment. The final section, on the electrical structure of matter, and the new physics, is perhaps the most ambitious in its comprehensiveness, for here the ramifications of the quantum theory are enlarged upon, with the addition, among others, of paragraphs on the Zeeman and Compton effects, artificial transmutation, neutrons, cosmic rays and wave mechanics and its developments. A complete enumeration would, in fact, cover almost every field of modern physical research. A detailed bibliography of works for subsequent reading is appended. Apart from some Wilson cloud track photographs, and in particular, excellent ones in connexion with the most recent work on disintegration and the neutron, the book is illustrated only by a sparse selection of conventional line diagrams.

It is undeniable that the authors have accomplished a remarkable undertaking. The text is thoroughly up to date, and readable in style, while the absence of heavy mathematics must commend the book to a wide circle. On the other hand, of course, the immense range attempted has necessarily restricted to a minimum the information on any given topic. The difficulty is to estimate the probable effect of a study of a work of this class on any particular type of reader. The person who wanted to know "a little about everything" would undoubtedly feel he was ideally served; the lay reader would probably be unequal to the task of orientating his mind to get a true perspective of modern science, although he could not fail to gain much useful information; the general scientific man might feel that he had been provided with a readily digestible refresher course, and the expert that the complex picture of contemporary science had been considerably clarified.

N. M. BLIGH.

Short Reviews

Handbuch der Biochemie des Menschen und der Tiere. Herausgegeben von Prof. Dr. Carl Oppenheimer. Zweite Auflage. Ergänzungswerk. Band 1, Halbband 1. Pp. xv+598. Band 1, Halbband 2. Pp. xv+601–1154. (Jena: Gustav Fischer, 1933.) 74 gold marks.

THESE volumes are of the kind that fill the user with awe-inspired gratitude and the reviewer with awe-inspired terror. That is to say, they are compilations exemplifying to the highest degree German thoroughness in surveying and abstracting literature.

The two volumes before us actually constitute two half volumes of a single volume; they run to 1154 pages altogether, of which the last 24 are devoted to a subject index. The double volume constitutes a supplementary volume to volumes 1, 2 and 3 of the second edition of the "Handbuch", published some eight to ten years ago. Presumably volumes 4–10 of the "Handbuch" will require at least another two supplementary double volumes also.

Even those who have some conception of the rapid strides made in biochemistry during the last decade must be astonished at the extent of the work done, as indicated by the scope of these supplementary volumes. A list of those who have collaborated in their production with Dr. Carl Oppenheimer, the editor, is sufficient guarantee of their adequacy in carrying out his ambitious purpose, which is to bring the original "Handbuch" so far as possible up to date at the end of 1932. The names of Profs. Abderhalden, Baudisch, Butenandt, Hoppe-Seyler, Krebs, Pringsheim, to take a half-dozen at random, make further recommendation supererogatory. It should be sufficient to say that the three original volumes of the work, to which these two volumes are supplementary, cover the building materials of animal tissues, the biochemistry of the cell, and the field of general immunological chemistry. This supplementary volume is indispensable to those who possess the main work, and will also be of great value to those who are not so lucky.

A. L. B.

The Romance of Research. By L. V. Redman and A. V. H. Mory. (A Century of Progress Series.) Pp. x+149. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1933.) 5*s*.

THIS book depicts, in concise yet lucid and felicitous terms, "the viewpoint of research and something of its methods, its developments, and its achievements". The man of science and the technologist, no less than the thinking layman, will find much that will interest them; but to no one will it make a stronger appeal than the research student, especially the young investigator who is on the threshold of an industrial career.

Notwithstanding the small compass of the book, the authors have succeeded in presenting a delightful sketch of the progress of research in many branches of biological and physical science, in showing how the community has benefited from the patient researches of those who sought no personal reward and in illustrating and explaining the major problems which must be solved before a laboratory discovery can be successfully translated to a large scale process As director and associate director of research to the Bakelite Corporation the authors have had ample opportunity of realising the advantages which result from sustained investigations so they do not hesitate to preach research to those who are more interested in its exploitation than in its promotion It is a stimulating book and deserves to be widely read W H B

Modern Coffee Planting By E G Windle Pp xi+232 (London John Bale Sons and Danielsson Ltd n d) 10*s* 6*d* net

The author of this book is a planter of more than fifty years experience in the coffee districts of South India His experience thus dates from the days when coffee was grown without shade before the disease *Hemileia vastatrix* levied such a heavy toll on this industry in the East The book is addressed to planters and is based on personal experience and observation It is seldom that one has the privilege of reading a book on a particular crop written by one who has made it his life study and has at the same time earned his livelihood from it Though written primarily for the coffee districts of South India where coffee has been grown since the seventeenth century the book should prove of great value to other coffee growing countries especially those where the industry is comparatively young Local conditions vary from one country to another but knowledge of a particular crop which has been acquired by experience will always prove useful elsewhere to anyone who makes an intelligent study of it

The dedication of this book to His Highness the Maharaja of Mysore in grateful acknowledgment of the benefit to the Coffee Industry resulting from the establishment of the Coffee Experiment Station at Balehonnur is welcome evidence that the author has put into practice the results of research to his own benefit

Constitution and Health By Prof Raymond Pearl (Psyche Miniatures General Series No 60) Pp 97+5 plates (London Kegan Paul and Co Ltd 1933) 2*s* 6*d* net

This little book is an expansion of a lecture given at the Army Medical Centre Washington It discusses the problems of the human constitution with the author s usual lucidity of style taking the view that the constitution of an individual is determined not only by his genetic inheritance but also by the exigencies of his lifetime such as the infections to which his body may have reacted producing immunity The constitution of an individual is therefore subject to change throughout his history and statistical treatments are necessary to determine the inter-relationships involved in the series of complex variables anatomical physiological psychological and pathological which characterise a human being The asthenic and pycnic types are regarded as merely extremes in a continuous series Dysplastic or asymmetrical types also occur having for example legs of one somatological type and trunk of another Such may be regarded as a coarse form of mosaic inheritance All the general modern biological interpretations are touched upon

Islands of the West By Seton Gordon Pp xv+211+47 plates (London Toronto Melbourne and Sydney Cassell and Co Ltd 1933) 15*s* net

Descriptive books on Scotland even of the west of Scotland have appeared in unusual numbers during the last few years most pitching their appeal to the alien tourist The book before us is not a guide book to the western isles but a series of essays dealing with one and another aspect of the islands and their life human and animal from Skye and the St Kilda group to Ailsa Craig and wandering beyond these bounds to Scilly and Connemara Yet we doubt if any other book can convey so vividly to the mind of the reader the loneliness and pathos as well as the *camaraderie* of existence upon these outliers of civilisation The result is partly due to the fine word pictures of the islands and their people but also to the way in which myth and tradition have been interpolated to illustrate a mental outlook which belongs to the past and as one would expect there is much said about the wild life of the places the author has taken such pains to visit The book is illustrated by striking and beautiful photographs

Die Faden Elektrometer Von Theodor Wulf Pp 147 (Berlin und Bonn Ferd Dümmler 1933) 6 gold marks

It is useful to have such a complete account of the string electrometers Although the theory relates to electrometers in general the greater part of the book deals with string electrometers Their construction use and calibration are described in great detail The double string electrometer is treated first and the single-string second In the latter case is a first account of the attainment of enhanced sensitiveness by using such potentials and distances between plates that the string is approaching an unstable condition The measurement and effect of the capacity of the instrument are described at length

Cours de mécanique rationnelle (Cours de la Faculté des Sciences de Paris) Par Jean Chazy Tome 2 *Dynamique des systèmes matériels* Pp vi+460 (Paris Gauthier Villars et Cie 1933) 80 francs

This volume takes the reader through the mechanics of systems following the work of the earlier volume on the dynamics of point bodies The two volumes together form a course which will supply the university student s need up to the stage required for the degree in mathematics

The Giorgi (M K S. Ω) System of Units

SEVERAL years ago, Prof Giovanni Giorgi, professor of mathematical physics in the University of Palermo, proposed a new system of electrical units At a meeting of a section of the Advisory Committee on Nomenclature of the International Electrochemical Commission in October last, a resolution was passed inviting national committees to express their opinions on the extension of the series of practical units at present employed in electrotechnics in the direction of Prof Giorgi's system

In this system there are four fundamental units, namely, the metre, kilogram, second and ohm

Dealing first with mechanical units and their relation to the C G S system, the changes are simple We then have

Length	1 metre	= 10^2 C G S units
Mass	1 kilogram	= 10^3 ,, ,,
Time	1 second	= 1 ,,
Velocity	1 m per sec	= 10^2 ,,
Momentum	1 kgm at a vel of 1 m per sec	= 10^5 ,, ,,
Force	1 vis*	= 10^5 dynes
Energy	1 vis acting through 1 metre	= 10^7 C G S units = 1 Joule
Power	= 10^7 C G S	= 1 watt

When, however, we pass to electromagnetic questions, we are met with a difficulty Maxwell attempted to express the measures of the various quantities occurring in terms of the three fundamental variables of mechanics—length, mass and time, and found that, without further assumptions, this was impossible

The fundamental electrical quantities are four in number, and other quantities occurring can be expressed in terms of these† We have the strength of an electric charge, ϵ, the strength of a magnetic pole, m, the permissivity of air, or a vacuum, K_0, the permeability of air, or a vacuum, μ_0 The measurements we make connecting these four quantities with our three mechanical units are three in number namely, the force between two charges, the force between two poles, the force between a current element and a pole, or alternatively, the force between a current circuit and a magnet Thus we have insufficient experimental results to express our four fundamental electrical quantities in terms of our mechanical units

We are left, as is well known, with the result that the dimensions of $\sqrt{\mu_0 K_0}$ are those of the reciprocal of a velocity, and we can proceed no further without some additional assumption We cannot say what are the dimensions of μ_0 and K_0 in terms of mass, length and time We know, of course, that the velocity is that of the propagation of electromagnetic waves, but that does not add to our knowledge of the dimensions of μ_0 and K_0 An additional fundamental unit is required

Maxwell's systems are based on one or other of two alternative assumptions one—the electrostatic system—that K_0 is unity and therefore $\mu_0 = 1/V^2$, where V is the velocity of wave propagation the other—the electromagnetic system—that μ_0 is unity and K_0 therefore equal to $1/V^2$ In the first, $K_0 = 1$ gives us the fourth fundamental quantity, while in the second $\mu_0 = 1$ takes its place as such

These are not, however, the only possible assumptions Any one of the quantities we wish to define might be assumed as a fundamental unit It might for example, be a quantity of electricity measured by its electrochemical effects, or in some other way independent of that already employed when measuring the force between two charges—this has been developed by Prof W Cramp in a letter to NATURE[1]—or a current of electricity measured in a similar manner This was Prof Giorgi s suggestion in some of his earlier papers

In his later papers, he adopts the resistance of a certain bar of metal, and thus we have his M K S R system Any suitable bar of metal might be taken for example, the resistance between the ends of the standard metre But it is universally agreed that any system of practical units must be the volt ampere ohm system, and this fixes the unit of resistance as 1 ohm Prof Giorgi therefore takes as his fourth fundamental unit a material bar having a resistance of 1 ohm, or more exactly 1 international ohm, and fixes on a column of mercury at a temperature of 0° C, 106 300 cm in length, having a mass of 14 4521 gm Thus except for the 4π question, we arrive at the M K S Ω system

The C G S system is based on Coulomb's law of force between two electric charges written in the form

$$\text{Force} = \epsilon\epsilon'/K_0 r^2$$

Prof Giorgi prefers to use Heaviside's form

$$\text{Force} = \epsilon\epsilon'/4\pi K_0 r^2$$

and thus eliminates the 4π in the expression for magnetomotive force

On the C G S system we have magnetomotive force $= 4\pi$ ampere turns and the unit of magnetomotive force is $1/4\pi$ ampere turn, whereas on the Heaviside system the unit is the ampere turn

The effect of this is to throw the 4π into the value of K_0 Thus we know that, in air, on the electrostatic system, when $r = 1$ cm $= 10^{-2}$ metre and $\epsilon = \epsilon' = 1$ C G S unit $= 10$ coulombs, then the force of repulsion is 1 dyne $= 10^{-5}$ vis

$$\text{Hence } 10^{-5} = \frac{1}{4\pi K_0} \times \frac{10^2}{10^{-4}}$$

$$\text{and } K_0 = \frac{1}{4\pi} \times 10^{11},$$

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* Vis is the name given by Prof Giorgi in one of his papers to the unit of force

† We might take other four quantities as fundamental, but this would not affect the argument.

or as Prof Giorgi writes it

$$K_e - \frac{1}{4\pi} \times 10^{9} L,$$

where L stands for the unit of length, the metre

In the above, for the sake of simplicity, Coulomb's laws have been assumed as the basis of the theory on which the system rests This, however, is by no means necessary In a very interesting article in the "Enciclopedia Italiana—Elettricita, Theoria della", to which Prof Giorgi very kindly referred the present writer in reply to a request for information on some points of theory, he has in the most lucid manner "developed the three fundamental schemes, pre Maxwellian, Maxwellian and electronic Any of these can be taken as the starting point

As Prof Giorgi stated in a paper read before the Electrical Congress at St Louis in 1904, neither the C G S electrostatic nor the C G S electromagnetic system is touched Scientific workers will be free to use any one of these systems without modification, or substitute for them his absolute practical system

To sum up, quoting again from the same paper "In order to derive electric and magnetic units from mechanical units, a fourth fundamental unit is necessary In the C G S electrostatic and the C G S electromagnetic systems, the fourth unit assumed is respectively the electrostatic or the electromagnetic constant of free ether, but this has many disadvantages For the absolute practical system the fourth unit is the ohm " It would be more accurate to say the international ohm, defined as the resistance of a certain column of mercury '

It should be noted, of course that the two changes from the C G S system suggested by Prof Giorgi are quite independent

Heaviside's suggestion as to the 4π could be introduced without adopting Prof Giorgi's proposal to take the international ohm as the fourth independent unit

R T G

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[1] NATURE 130 368 Sept 3 1932

√ The Inheritance of Acquired Habits

By PROF E W MACBRIDE, F R S

FOR the last five years, experiments to test the heritability of acquired habit have been in progress in the Zoological Laboratory of the Imperial College of Science under my supervision and an account of the work may be of interest to readers of NATURE

The first part of the results of these experiments has been published by the Royal Society the second part is almost ready for publication Miss Sladden, who carried out the work began by rearing the young of *Salamandra maculosa* and the eggs of *Alytes obstetricans*, thus endeavouring to repeat Kammerer's work It became evident, however, that we did not possess the equipment necessary to provide the conditions which would induce these animals to breed We succeeded in confirming some of Kammerer's statements about the effect of the environment on the habits of one generation Thus it is quite possible to induce *Alytes* normally a land animal, to adopt an aquatic life, and in regard to *Salamandra* we were enabled to explain Herbst's failure to obtain Kammerer's results

There are two distinct races of *Salamandra maculosa*, an eastern and a western In the latter, which inhabits the Jura and the Vosges, the yellow pigment is arranged in two longitudinal bands on the back, over a general body colour of black Miss Sladden has reared animals of this race from birth to an age of three years in boxes painted inside with bright yellow and also in boxes painted deep black inside In neither case could we detect any alteration in the amount of yellow pigment as a result of the colour of the background In the eastern race, however, which formed the subject of Kammerer's researches, the yellow pigment is arranged as a series of spots over a black background, and by experiments conducted by Mr E Boulenger, then curator of reptiles in the Zoological Gardens, and by myself, during the years 1919–1924 we were able to show that animals of this race exposed for long periods to a black environment do show definite reduction of the yellow pigment But even if Miss Sladden had been successful in getting her animals to breed, the length of time involved would have been prohibitive, since the adult condition is only attained after four years' growth Therefore we sought for a convenient experimental animal in which the generations succeeded each other more rapidly

Some years ago (1912–1915), in conjunction with another pupil (Miss Jackson, afterwards Mrs Meinertzhagen), I conducted experiments on breeding the stick insect, *Carausius morosus*, and I found that this insect, whose normal food in England is privet, could be forced by starvation to feed upon ivy I therefore suggested to Miss Sladden that she should test the development of this ivy feeding habit This insect offers great advantages when used as an experimental animal It is parthenogenetic males only appear in small numbers every five or six generations and when they do appear they are at once recognisable by their smaller size and different coloration The parthenogenetic insect produces about 150 eggs a year which take about three months to develop there is no metamorphosis and as there are no wings the nymph is morphologically similar to the adult

The plan adopted was to isolate the just hatched young, keeping each one in a separate box These boxes were made of metal they were circular and had glass covers In each box was placed a small piece of ivy leaf At the end of two days about ten per cent of the insects had begun to eat ivy, the rest had not touched it. If we had reared from these insects alone we should have been accused of selection; but we adopted a different plan (suggested by my colleague, Mr. Hewer). The ninety per cent which refused ivy were given a bit of privet leaf to eat and so rescued from starvation. Then after one day the privet was removed and the insect was again provided with ivy. This second provision of ivy was called the 'second presentation'. If after two days more the insect still refused ivy, it was again given privet for a day. The majority of the insects accepted ivy at the second presentation; but some held out until the third, fourth, or even fifth, presentation, and one recalcitrant held out until the tenth presentation.

We started the experiments with 125 females. All the young which accepted ivy at the same presentation, to whatever mother they belonged, were classed together, and when they in turn became adult the eggs of each class were mixed together. From each mixture 100 eggs were selected in order to rear the next generation. In the second generation, in place of ten per cent no less than eighty per cent of the insects accepted ivy when first presented, that is, at the first presentation; in all, 800 insects were tested. In the third generation ninety-five per cent accepted ivy at the first opportunity and 2,000 insects were tested.

Thus with these insects, we reached exactly the same conclusions as those arrived at by Prof. McDougall with regard to induced habits in rats; namely, that when members of one generation are compelled to adopt a new habit, a residual effect of this habit is carried over to the next generation, so that the young insects adopt the new habit more quickly than did their parents. We claim, however, that the stick insect gives more conclusive results than the rat; because although we think that Prof. McDougall has overcome all his difficulties, yet there were very serious objections to be faced with rats, such as possible mass suggestion, parental training, etc., which are obviously inapplicable to insects.

What many people fail to realise, however, is that this transference of a residual effect of habit is the central principle of Lamarckism, clearly and unequivocally expressed by Lamarck himself. He said that "the environment produces no direct effect on the animal", but by making new needs (for example, the necessity of eating ivy or starving) it forces the animal to make new efforts to satisfy them, and 'if these needs *continue for a long time* then the animal's efforts become habits'; and habits by causing the use of some organs more and others less bring about the enlargement of the former and the diminution in size of the latter, and these changes are preserved by reproduction.

This article is written in the hope that other investigators will take up this question and repeat the experiments using other animals, especially other insects, as subjects; for only by such experiments can this fundamental principle be settled. Indeed, experiments with the larvæ of moths were begun some years ago by Dr. Thorpe, of Cambridge. The attractive feature about such experiments is that the percentage of mortality is very low, so that the agency of 'chance' or 'natural selection' is excluded. Prof. Woltereck, whose great book "Grundzuge einer allgemeinen Biologie" was reviewed in NATURE of December 17, 1932, removed Cladoceran Crustacea from northern lakes to Lake Nemi in Italy. When he examined the transported stock after twenty years he found them much altered in shape; when he again re-transferred some of this stock to the post-glacial lakes of their ancestry they reverted to their original shape—but only *gradually during the course of several generations*.

The Linnean Society recently had the privilege of hearing Prof. Woltereck deliver an address on the fauna of recent lakes in many lands. Summing up the evidence, Prof. Woltereck concludes that the time since the recession of the ice of the last phase of the glacial age, that is, about 10,000 years, has only sufficed for the production of new races; for the production of new species we must go back to pre-glacial times possibly 500,000 years ago. As I remarked in my comments on the lecture it would be hard lines on the experimenter if he had to live and experiment for 10,000 years before he could hope to produce a new heritable *structure*; but heritable changes of *habit* in small rapidly breeding animals may be observed after experiments *lasting from five to ten years*.

Students of mutation, that is, 'geneticists', will naturally inquire what is the relation between these changes of habit and mutations. That is a question for future study; here only certain tentative suggestions can be offered. From the study of the few cases in which mutations have been experimentally produced by such agencies as X-rays and heat, it may be concluded that they are due to some damage to the developmental machinery of the nucleus in the germ cells. They, and not the Lamarckian changes, are the results of the 'direct action of the environment'. So long as malign conditions surrounding early development persist, the mutations are faithfully inherited, but if the organism can be replaced in its natural environment, then in a limited number of generations they pass off and the original constitution reasserts itself. In 1790 Capt. Cook introduced the English domestic pig into New Zealand in order to induce the Maoris to abstain from cannibalism. The animals escaped into the woods, and by 1840 had increased to herds of at least 40,000 in number and had assumed all the characters of the ancestral wild boar, including the fierce tusks—although in New Zealand there were no enemies which required such weapons to drive them off. Mutations seemingly are more surface phenomena than racial habits; they are indeed what Johannsen, the inventor of the word 'gene', called them, "superficial disturbances of the chromosomes", but racial habits belong to the inmost core of the heritable constitution.

The British Postgraduate Medical School

LONDON has a supply of clinical material—that is, cases of sickness and disease—almost unique in amount and variety, which should be available for teaching and research. Some of this material is utilised by the medical schools in their attached hospitals for the training of their undergraduate students, whom they must in the main serve, and their facilities for the additional training of the postgraduate student are necessarily limited. In fact London has hitherto lacked an organisation for postgraduation study comparable to the continental centres such as Vienna. London's wealth of clinical material should be available for the provision of courses of advanced instruction for qualified doctors resident in Great Britain, in the Empire beyond the seas, and abroad, who wish to refresh or extend their knowledge, or to obtain the latest information on new developments in medicine, surgery and obstetrics.

Attempts have been made in the past to institute courses of postgraduation study. In the closing years of last century the Medical Graduates College and Polyclinic, organised in the main by Sir Jonathan Hutchinson, gave courses of systematic lectures in various branches of medicine in association with classes and clinics in certain special hospitals and medical schools but it could not provide that regular attendance at in- and out-patient departments which is one of the principal requirements of the general practitioner and of the specialised postgraduate student. Postgraduate courses of instruction have also been organised by some of London's hospitals which have no medical school attached for example the West London, Hammersmith, the Prince of Wales, Tottenham, and the Seamen's Hospital, Greenwich.

Another organisation which has done and is doing, much good work in the direction of postgraduation study, is the Fellowship of Medicine and Post-graduate Medical Association, with which the name of the late Sir William Osler should be remembered. But its scope is limited much in the same way as in the Polyclinic.

The serious consideration of the problem of a postgraduate medical college dates back to 1921, when Dr. Addison, then Minister of Health, at the suggestion of the University Grants Committee, formed a Committee under the chairmanship of the Earl of Athlone to consider, among other matters, the provision in London of a school with hospital attached to be devoted to postgraduate instruction in medicine, and of an institute for instruction in public health subjects. Largely by the aid of a very generous grant from the Rockefeller Foundation, the last-named institution was the first to be established and the buildings of the London School of Hygiene and Tropical Medicine were opened in July, 1929.

The other objective of the Athlone Committee still remained to be secured, but the post-War depression had already begun and the scheme remained in abeyance for a time. Then Mr. Neville Chamberlain set up another committee, the terms of reference of which were "to draw up a practicable scheme of postgraduate medical education centred in London". This Committee surveyed the situation, and came to the conclusion that it was impracticable to establish a new school with hospital attached, or to associate the new school with any existing teaching hospital. But fortunately, by the passing of the Local Government Act of March, 1929, between twenty and thirty municipal general hospitals, formerly under the Poor Law, came under the control of the London County Council, and a scheme of associating the proposed postgraduate medical school with one of these institutions was then explored. With the full co-operation of the London County Council, the unanimous conclusion was finally reached that the conversion of the hospital in Ducane Road, Hammersmith, was the best solution of the problem. Here there were 400 beds housed in a building no part of which was more than twenty-five years old, and which had been described as "exceptionally good and well designed for the purposes of a hospital dealing with the acutely sick".

In April, 1930, Mr. Greenwood, then Minister of Health, announced the Government's acceptance of the Committee's recommendations and its willingness to contribute a sum up to £250,000 for building and equipping the School, together with annual grants for maintenance through the University of London. Following the recommendations of another Committee over which Lord Chelmsford presided a Royal Charter was granted to the School on July 10, 1931. Unfortunately, shortly afterwards the financial crisis developed and jeopardised the whole scheme but after serious consideration the Government of the day decided that it was against the public interest to postpone the scheme indefinitely, and offered to make a grant not exceeding £100,000, and the L.C.C. agreed to expend a similar sum towards adaptation of the existing Hospital for the purposes of the School.

Financial reasons again delayed the commencement of building, but the foundation stone was laid by Mr. Neville Chamberlain in July last year, and substantial progress has since been made in the adaptation of the existing buildings and provision of the new ones required.

The L.C.C. is providing, on the hospital side, new blocks for midwifery cases, for out-patients, and for casualty departments, while the School buildings will consist mainly of laboratories, lecture theatres, and accommodation (non-residential) for the teachers and students. The Dean of the School, Dr. MacKeith, has recently issued a circular descriptive of the general plan of the buildings and of the accommodation provided.

The University of London has also recently recognised' the new institution as a school' of the University, and four chairs have now been advertised, in medicine, surgery, obstetrics and gynæcology, and pathology Presumably assistants will also be needed for each unit, and it may be anticipated that courses will also be delivered from time to time by eminent physicians, surgeons and others not permanently attached to the School In addition, the courses in present postgraduate centres will still be made use of so far as possible

Thus, after many vicissitudes, a postgraduate medical school worthy of the great Metropolis has come into being which it may be anticipated will in the future raise the standard of professional skill among the great body of medical practitioners, and will advance the progress of medical science by research carried out within its walls

Obituary

PROF CAMILLE MATIGNON

ARTHÈME CAMILLE MATIGNON, president of the French Chemical Society who died suddenly in Paris on March 18 was a leading figure in pure chemistry and a great exponent of chemical technology Matignon was born at Saint Maurice aux Riches Hommes Yonne on January 3 1867 and entered the Ecole Normale Paris in 1886 three years later he became assistant to Berthelot at the Collège de France and commenced a long series of original contributions to our knowledge of thermochemistry After spending five years at the University of Lille as lecturer and professor he was appointed as a temporary professor at the Collège de France in 1902, a supplementary professor in 1903 and, on the death of Berthelot, became professor of inorganic chemistry in 1908 holding this post until his death

Matignon early concerned himself with the great problem of the fixation of atmospheric nitrogen and the synthetic production of ammonia he studied the direct combination of many of the metals with nitrogen, showing that zinc dust always contains zinc nitride, and preparing the nitrides of a number of the rare earth metals Certain of the nitrides, such as those of silicon and aluminium, were probably formed during the cooling of the earth and, by the action of water vapour, gave ammonia, the first form in which nitrogen became available for assimilation by plant life Matignon maintained that the increased use of artificial nitrogenous fertilisers was essential to the development of French agriculture, he followed up the advocacy of this principle by working out methods for the economic production of phosphates and potassium salts for use as manures

With the aid of the calorimetric bomb, Matignon determined the heats of combustion of a long series of substances and, since many of these were closely related organic compounds, he was able to deduce a number of interesting generalities from the heats of formation His more extended studies of the part played by heat in chemical reactions led him to the statement of an empirical law of thermodynamics which Nernst termed the Le Chatelier Matignon rule' This states that for gaseous equilibria in which one gaseous and one or more solid phases are concerned (sublimation of solids, dissociation of calcium carbonate, etc), the relation $Q/T = 32$ holds approximately in all cases Q being the heat evolved at constant pressure and T the absolute temperature at which the gaseous pressure attains one atmosphere This empirical law is an extension to chemical dissociation of Trouton s law concerning heats of vaporisation The Le Chatelier Matignon rule can be stated in several ways and may be used to foretell whether certain reactions can take place and whether they are reversible Thus it was foreseen that hydrogen sulphide should react with potassium carbonate but not with sodium carbonate at the ordinary temperature, these deductions were verified by experiment Matignon's achievements in these and many other fields were recognised by his election to the Institut de France in 1926

Matignon was an eloquent speaker and wrote in a lucid convincing style He assumed the editorship of the *Journal* of the French Society of Industrial Chemistry at its inception in 1918, and the editorial which he wrote each month until the end of his life was read with interest by the whole chemical world, the last of these articles—on the fiftieth anniversary of the death of Dumas—appears in the March number of *Chimie et Industrie* which was published a few days ago Matignon s striking personality and his gay vivacious enthusiasm made him a notable figure He did much to promote the re establishment of those normal relations between scientific men throughout the world which had been so rudely shattered by the War, he had many friends far outside his own country who will remember him with respect and affection

W J POPE

MR E G B MEADE WALDO

IT is with great regret that we have to record the death of Mr Edmund Gustavus Bloomfield Meade Waldo, of Stonewall Park, Chiddingstone, Kent, who died on February 24, aged seventy-nine years Only son of Mr Edmund Waldo Meade Waldo, of Hever Castle and Stonewall Park, he was born at Holly Brook, Co Cork, on February 8, 1855, and educated at Eton and Magdalene College, Cambridge His room at Eton was a menagerie of wild animals, and rumour has it that, while at Eton, his overpowering ambition was to kill one of the red deer in Windsor forest, and that this ambition was fulfilled In 1880 he married Ada Coralie, a daughter of the late Lord Justice Baggallay and he and his wife went to live for some time at Rope Hill in the New Forest The New Forest as was only natural brought out all that passionate love of Nature and animal life which had already begun to show itself at Eton

Like his life long friend Herbert St Quintin of Scampston Hall Yorkshire who died a year ago Meade Waldo was a born naturalist and both were fortunate in having leisure to develop more and more their powers of observation in all branches of natural history It is said that they corresponded almost every day of their lives and needless to say the subject of this correspondence formed an almost daily diary of what they had observed in the field of Nature If the many facts comprised in these remarkable series of letters could be gathered up it is probably no exaggeration to say that they would vie with those contained in White s Natural History of Selbourne

Both these friends were ardent hawkers and in this fascinating pursuit such other well known hawkers and naturalists as Lord Lilford Aubyn Trevor Battye W R Ogilvie Grant the Hon Gerald Lascelles Col H Barclay and the Rev Gage Freeman and others were very closely associated Meade Waldo s diaries contain many records of famous hawks and their prowess in the chase

Meade Waldo s life represents a page in the history of ornithology which is not likely to be rewritten Another of his intimate friends was the late Henry Elwes a man passionately fond of God s open spaces in many countries a naturalist in every sense of the word the author of one of the finest books on trees ever written Lord Grey of Fallodon was another friend after his own heart and Herbert St Quintin Meade Waldo and Grey forgathered every year at Fallodon All three have died in the last year and to those in sympathy with the point of view they represented their passing will inevitably represent a lost link with the ornithology of the past

But Meade Waldo s activities in the realms of Nature were not confined to his own broad acres or those of his friends He studied birds in Spain as also in Morocco where during a long residence he explored the Atlas Mountains in days when travel in that country was not the easy matter it is now He was also intimately acquainted with the birds of the Canary Islands and was one of the late Lord Crawford s guests on his voyage to Madagascar and the Comoro Group in his famous yacht the *Valhalla*

Meade Waldo was also an ardent supporter of the various societies for the protection of bird life the fauna of the Empire and the establishment of nature reserves while he took the deepest interest in the welfare of the Zoological Society of London of which he was a vice president and a member of the Council He was indefatigable in his attendance at the many meetings which such work involved

MR JOHN POWER

BY the death on January 27 at Rosebank near Cape Town of Mr John Power one of the few remaining direct links with the Royal Observatory Greenwich under the administration of Sir George Airy has been broken

John Power was born in Waterford Ireland on July 14 1860 He entered the Greenwich Observatory in 1875 six years before the retirement of Airy In 1891 he left to take up the appointment of secretary and librarian to the Cape Observatory under Sir David Gill In 1895 he was appointed a junior assistant being succeeded as secretary after a short interval by the late Dr R T A Innes who afterwards became the first Union Astronomer In 1905 Power was promoted to the rank of assistant From 1897 until his retirement in 1920 he was in charge of the miscellaneous computing department In that capacity he was responsible for the preparation and proof reading of the following catalogues (the dates of publication are in brackets) —Cape General Catalogue for 1890 (1898) the Cape General Catalogue for 1865 (1899) the Cape Astrographic Standard Star Catalogue (1906) the Cape Catalogues of Special Stars for 1900 (1906) the Cape Catalogue (Boss s Stars South of 36) (1907) the First Cape Fundamental Catalogue for 1900 (1915) the Second Cape Fundamental Catalogue for 1900 (1920) and the Cape Zone Catalogue of 20 843 stars for 1900 (1923) He showed remarkable industry and devotion in this work spared no efforts to ensure accuracy in all details and was very skilled in marshalling large masses of numerical data He rendered also very valuable services in connexion with the revision and control of the co ordinates of the plates for the Cape zones of the Carte du Ciel work and in their preparation for press For many years he was a regular and active observer with the transit circle

Power was much interested in local and municipal affairs He was largely responsible for the inception of a public library in Observatory (the suburb adjacent to and named after the Cape Observatory) of which he was chairman for many years preceding his death He was also for many years a member of the Cape School Board of which he became successively vice chairman and chairman After his retirement he devoted a great deal of his time to the work of this body on which he will be greatly missed Financial approval for carrying out the programme of the Board was often difficult to obtain but Power s Irish extraction showed itself in his love of a fight and he was at his best in defending his policy and attacking his opponents The cause of elementary education at the Cape owes a great deal to his efforts

Mr Power was a widower and his only son, who had had a brilliant career at Oxford as a Rhodes scholar was killed in action in East Africa

Prof J R Ainsworth Davis

PROF AINSWORTH DAVIS was born at Bristol in 1861 the son of the Rev James Davis He studied under Profs Huxley and Judd at the Royal School of Mines London and afterwards at Trinity College Cambridge where he gained a first in both parts of the Natural Science Tripos Shortly afterwards appointed lecturer at the University College of Wales Aberystwyth he threw himself into the work of that institution and was elected professor of zoology and geology He was a teacher of marked power and strong personality with an unusual gift for epigrammatic statement and he sought to understand and help his students outside as well as inside the class room His home was always open to students and colleagues and his versatility showed itself in amateur acting verse writing organising and commanding the college O T C campaigning for the hall of residence for women students—one of the earliest of these institutions as well as in scientific writing In the latter field he wrote papers some in collaboration with his students on molluscan morphology but his chief interest was in teaching and his textbook of biology his Natural History of Animals and other works have been widely used

In 1908 Ainsworth Davis became principal of the Royal Agricultural College Cirencester and from 1914 on he served as army instructor with the rank of major acting at one time as chairman of the Central Civilian Advisory Board at G H Q After demobilisation he lectured in biology at Middlesex Hospital Medical School and then gave his services as writer and lecturer to the Empire Marketing Board

His was a life of varied activity the outcome of a keen mind deeply interested in the life of his time He is survived by his wife daughter of the late Mr James Coutts of Edinburgh and by his son Dr J C Ainsworth Davis who has been a distinguished athlete

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WE regret to announce the following deaths

Herr Oskar von Miller founder and until 1933 president of the Deutsches Museum at Munich and formerly a chairman of the World Power Conference aged seventy eight years

Prof Augustus Trowbridge professor of physics and since 1928 dean of the Graduate School of Princeton University an authority on explosive mixtures on March 14 aged sixty four years

Prof F P Venable emeritus professor of chemistry in the University of North Carolina and president of the University in 1900–14 on March 18 aged seventy eight years

News and Views

The Hon John Collier

THE death of the Hon John Collier on April 11 at the great age of eighty four years recalls his signal services to men of science in the art of portraiture The National Portrait Gallery possesses the popular and appealing canvas of Darwin standing clad in a cloak holding his hat in the left hand and looking straight towards the spectator Here too may be seen Collier s representations of Huxley Sir Michael Foster Sir William Huggins and W K Clifford mathematician physicist and philosopher The Royal Society is especially fortunate in examples of Collier s faithful portrayal of a select circle of men of science In its gallery are portraits of James P Joule William Spottiswoode Sir Joseph Hooker and Sir William Huggins while Sir Michael Foster is included in replica A portrait of the late Prof S H Vines hangs in the rooms of the Linnean Society

Mr Richard Inwards

VERY hearty congratulations are extended to Mr Richard Inwards who will reach the age of ninety four years this week (whilst yet happily in good health) having been born on April 22 1840 Elected into the Royal Astronomical Society so far back as 1861 he is we believe the oldest member of that body also of the Royal Meteorological Society whose ranks he joined a year later Early in life Mr Inwards became a mine manager in Bolivia and afterwards he acted in a like capacity in Spain for the Manganese Company Later on mining projects and enterprises led him to widely divergent places—to Norway Austria South America Mexico Settling in England meteorological studies became his prime interest and he was for nearly twenty years joint editor of the *Quarterly Journal of the Royal Meteorological Society* becoming in 1894 president of the Society serving the customary period Exactly forty years ago corresponding with the present month Mr Inwards read a paper entitled On Some Phenomena of the Upper Air A contribution (1907) The Metric System in Meteorology survived criticism at any rate for publication in the *Quarterly Journal* some will perhaps recall the discussion Mr Inwards is the author of Weather Lore and The Temple of the Andes , also he published (1911) an interesting reminiscent biography of W Ford Stanley F R A S in memory of that gifted mechanician responsible for many developments in the designs for mathematical drawing surveying and levelling instruments

A Broadcast from the Antarctic

THE B B C included in its programme on the evening of April 14 an interesting item which took the form of a short broadcast from Admiral Byrd s Antarctic expedition the main base of which is at Little America Bay of Whales in latitude 78° S The transmission was effected through the agency of the Columbia Broadcasting System of America, which has a representative with the expedition giving regular talks to listeners in the United States. The signals from the expedition's transmitting station at the Bay of Whales were received in South America, relayed to New York and thence to England and several other European countries. In addition to announcements by the representative mentioned above, members of the party gave a brief account of the prevailing meteorological conditions and of the scientific work being carried out by the expedition. The average daily temperature was stated to have been between −20° and −60° C., while a thirteen days' blizzard had been experienced recently. Admiral Byrd's advance party is located at about 123 miles nearer the South Pole than the main base at Little America. The brief programme included a musical item by members of the expedition and concluded with the singing of the British national anthem. Although reception was marred to some extent by distortion and a fairly high noise level, this broadcasting achievement showed in an interesting manner the possibilities of modern radio communication, and demonstrated that the isolation of polar expeditions is a thing of the past.

Broadcasting over Wires

At a meeting of the Wireless Section of the Institution of Electrical Engineers on April 11, a paper entitled "Principles of Audio Frequency Wire Broadcasting" was read by Mr. P. P. Eckersley. It is well known that too few wave-lengths are available for the purposes of wireless broadcasting, a limitation which makes it impossible to give all listeners both a variety of choice of programme and good quality reproduction. These limitations have stimulated an interest in alternative methods of distributing programmes to listeners, and broadcasting over wires has certain basic technical and economic advantages over wireless broadcasting. Wire broadcasting technique has been extensively applied in Holland, where 50 per cent of the Dutch listeners have their programme service laid on to the house by a wire connexion. Relatively slight developments of the same nature have taken place so far in Great Britain, although a number of companies are in operation for the re-diffusion of the ordinary wireless programmes.

The commonest form of such re-diffusion takes place at audio frequencies; the ordinary wireless broadcasting programmes are picked up by a receiver located where reception conditions are favourable, and the audio frequency output of this receiver is of sufficient strength to energise at once a thousand or more loud speakers connected to it by a line network. It is usual to connect each subscriber by two lines to this network so that a choice of two programmes is provided. Mr. Eckersley's paper dealt with the technical problems encountered in the design and construction of such a network in order to give a good quality service. An analysis was made of the effects set up by the interaction of the reactances and resistances composing the network and the loud-speakers, and it was shown that the received level, particularly towards the ends of the lines, varies with loading and frequency. Certain generalised rules have been evolved to indicate how the distortions incidental to this form of wire broadcasting may be minimised or even eliminated.

Commercial Production of Heavy Water

The recently discovered 'heavy water', which has created so much interest in popular as well as scientific circles, is to be produced commercially in England. Plant has been developed at the Billingham works of Imperial Chemical Industries, Ltd., which is capable of producing a continuous supply of heavy water of approximately 30 per cent purity at the rate of 5 gm. per day, while approximately pure 'heavy water' will be produced at a somewhat later date. I.C.I. anticipate that they will be able to meet any commercial demand that may arise. Urey and Washburn, in the United States, discovered that the residual water in old electrolytic cells contained a larger proportion of heavy hydrogen than the normal. It was further found that by continued electrolysis, the concentration of the 'heavy water' was enriched, ordinary light hydrogen being given off preferentially, and 'heavy water' accumulating. This gave the key to a successful method of preparing 'heavy water' in quantity, and the electrolytic method is the one in use at Billingham. Large-scale production of 'heavy water' is only possible where exceptional resources of power and raw materials exist together. At Billingham, not only ordinary hydrogen in large quantities, but also residues in which 'heavy water' has accumulated, are readily available. These resources, together with cheap power and convenient research facilities, make Billingham a logical centre for the large-scale production of the new compound. Since its discovery in the United States, its probable uses are becoming more evident, and it is eloquent testimony to the vitality of British chemical technique that in so short a space of time it should have been translated from a scientific curiosity to a marketable commodity.

The 24-Hour Time System

The British Broadcasting Corporation will adopt the 24-hour system of expressing time from April 22, when 'summer time' commences in Great Britain. The system will be used in all announcements over the microphone, in the journals published by the Corporation and in correspondence. No statement has been made as to the duration of the trial of the system, but it will doubtless be sufficiently long for the public to become thoroughly familiar with the system and for the extent of public approval or disapproval of the system to be gauged. As already announced in Nature, the Postmaster General will await the result of this experiment before coming to a decision on the question of the adoption of the system in the Post Office. It is proposed by the B.B.C. that a time such as 17 h. 15 m. shall be announced as 'Seventeen fifteen hours'. This terminology would be inaccurate and undesirable, and it is to be hoped that such a designation will not be used, otherwise this phraseology may soon become stereotyped The expression 'seventeen hours fifteen minutes' is accurate but long seventeen hours fifteen' is a contraction analogous to seventeen pounds fifteen' for £17 15s 0d But seventeen fifteen' (analogous to the present 5 15 p m, but with the now unnecessary p m dropped) should be quite sufficient At the exact hour, 17 hours can be used as simpler than 17 00

Origin of Tektites

THE suggestion first made in NATURE (131, 117, 1933) by Dr L J Spencer that tektites have been formed by the fusion of terrestrial rocks by the fall of very large meteorites has given rise to an interesting discussion, but, being unexpectedly novel, it has not met with general acceptance Prof F E Suess of Vienna, in whose classical paper of 1900 the name tektite was introduced and the meteoritic theory first proposed, has returned to the subject and he gives a recent review in *Die Naturwissenschaften* (21, 857, Dec 8, 1933) Here, and in a private letter, he admits that the Darwin glass of Tasmania may have been formed by the fusion of terrestrial material Some of the silica glass from the meteorite craters at Wabar in Arabia is, in fact, exactly like Darwin glass in every respect, and at both places the material is present in thousands of tons But from Tasmania no meteoric iron or craters have been recorded For other tektites (australites, billitonites, moldavites and indochinites'), Prof Suess still holds to the meteoritic theory He points out that they have a much wider distribution than the silica glass found around meteorite craters, and also that they usually bear no relation in chemical composition to the underlying rocks The same arguments are also put forward in a letter to the Editor from Mr T Hodge Smith, of the Australian Museum, Sydney, who has given an account of the tektites recently found in the Philippine Islands These arguments, however, overlook the fact that tektites are usually found in alluvial deposits and that they are often water worn and corroded, indicating that they have been transported from their place of origin In the case of australites found scattered on the surface of the ground over wide areas, it is conceivable that they have been transported by the natives

The 200 inch Reflector

IT was reported in the *Times* of March 27 that an accident had occurred during the pouring of the twenty tons of glass into the mould of the two hundred inch mirror for the new reflector for the California Institute of Technology Part of the mould came loose and floated to the top of the molten glass As soon as the pouring was completed, the cores were fished out of the molten mass According to a message issued by Science Service, Dr Hostetter, who was in charge of the operations, said that this mishap would not affect the success of the mirror, which has now been set aside to cool very slowly After the months of cooling have elapsed, it will take several years to grind the surface of the mirror Our readers will join with us in expressing the hope that it will be found that the incident of the break up of the mould will not have spoilt the present pouring of glass

Refrigeration Exhibition at the Science Museum

SIXTY years ago mechanical refrigeration was just coming into existence, and yet to day it is an essential part of everyday life, not only in its well known application to the transport and storage (including domestic storage) of perishable foodstuffs, but also in many of the industries upon which Great Britain depends Of its lesser known uses mention may be made of the manufacture of bread, biscuits, chocolate, margarine artificial silk stockings and cinematograph films, the brewing of beer, the curing of bacon, the refining of oil and the sinking of mine shafts and wells These are a few of about three hundred industries in which its use is either essential or in which it improves the quality of the product With the object of illustrating the part played by refrigeration and of showing the public the principles on which the several types of machines operate, a special exhibition has been arranged at the Science Museum South Kensington and will remain open until the end of August It consists mainly of models, working exhibits and demonstrations The exhibits have been supplied by the manufacturers and users of refrigerating machinery and the Museum has had the wholehearted co operation of the British Association of Refrigeration, the National Physical Laboratory and the Low Temperature Research Station A small Handbook has been prepared and will be on sale at the price of 6*d* (by post 7*d*) copies may also be obtained from H M Stationery Office Anyone who is interested in the subject may obtain from this Handbook in a concise form an idea of the modern science and practice of mechanical refrigeration the handbook also contains a brief outline of its historical development In addition, a bibliography on refrigeration has been prepared in the Science Museum Library and will also be on sale

Models of Tidal Estuaries

AT the Friday evening discourse held at the Royal Institution on April 13, Prof A H Gibson discussed 'Tidal Estuaries Forecasting by Model Experiments' During recent years much work has been done on models reproducing the flow of water over weirs, through sluice gates, etc, and it has been found that, if suitable precautions are taken, the model results give a reliable indication of the behaviour of the original River flow models are now being extensively used to investigate the erosion and deposition of bed materials and the effect of works designed to improve the navigable channel The technique of such investigations is not yet fully developed, different methods being used in different laboratories Chronologically, models of tidal estuaries were used before those of uni flow rivers, the first tidal models (of the Mersey Estuary) having been constructed by Osborne Reynolds in 1885

In 1926 the Severn Barrage Committee of the Department of Civil Research decided to carry out investigations on a working model of the Severn Estuary with the view of determining the probable effect on the physical and hydrodynamical features of the estuary of the introduction of a barrage for generating tidal power at the English Stones between Beachley and Avonmouth This model was constructed and operated in Prof Gibson's laboratory

PROF GIBSON dealt with the problems involved in the construction and operation of such models and with a comparison of the results obtained from the Severn model with those observed in the estuary The successful use of a model depends largely on its being of a suitable scale and on the possibility of being able to reproduce with reasonable accuracy the physical conditions tending to produce movement of the bed materials This is more easily accomplished in an estuary having well defined physical characteristics with a large tidal range in which the action of the ebb and flood currents are all important In such a case experience shows that the behaviour of the model reproduces closely that of the estuary In other types of estuary having comparatively small tidal ranges and especially if very exposed to gales the results are mainly likely to be of value in so far as they enable the effect of any training works on the set and velocity of the currents and on the tidal range and period to be determined

Close of Excavations at Ur

WITHIN a few days of the publication by the British Museum of the volume reporting on the excavation of the Royal Tombs at Ur Dr C Leonard Woolley in the *Times* of April 13 announces the close of the brief season's work and with it the end of the joint expedition of the British Museum and the Museum of the University of Pennsylvania to Mesopotamia For twelve years this expedition has been engaged in an excavation which has produced results comparable in their far reaching effect on archæological studies with the epoch making discoveries of Sir Arthur Evans in Crete The results reported by Dr Woolley in what all will regret to know is his final dispatch in the long series he has contributed to the *Times* since 1922 form a fitting and impressive climax to what has preceded The main objective of the season was the discovery of a cemetery of the early Jemdet Nasr period for which the search in default of guiding indications was in the nature of an act of faith It was abundantly justified by the discovery after prolonged and strenuous digging of a stratum of 10 ft containing burials in the upper levels of which the characteristically flexed human skeletons were surrounded by large numbers of stone jars in a variety of forms and material One grave alone contained thirty three vases In the upper range the stone vase had entirely ousted that of clay As Dr Woolley remarks it was a luxury that had become a commonplace As Ur stands in a stoneless land and the material had to be brought from either the north of Mesopotamia or from the area of the Persian Gulf it would be difficult to find a more impressive testimony than this closing discovery to the early accession of Ur to wealth and importance of which Dr Woolley's excavations have afforded cumulative evidence year by year

SINCE the trial excavations made by Dr R Campbell Thompson at the end of the War for the purpose of a report to the British Museum and the more or less tentative expedition of the late Dr H R Hall to Ur and Al Ubaid before Dr Woolley began systematic excavations in 1922 the archæology of the Middle East has advanced far and fast Stimulated by Dr Woolley's results expeditions have worked at Kish Nineveh Arpachiyah Tell Asmar and elsewhere each site helping in the work of amplifying and elucidating material which in the long run it is not unfair to say gains its full significance by reference to the evidence from Ur and the outline of early Mesopotamian history which that site has afforded It will be some time perhaps years before the place of Ur in archæological studies will have attained its final adjustment Possibly from this point of view it may be no bad thing that further discovery here has ceased for the time being affording an opportunity for comparison and reflection Results must be weighed and pondered they must be brought into closer relation with what has been done on the fringes of this great archæological province It may then appear that by no means the least important outcome of the broader view now taken of the archæological field of which Ur has been made the centre has been its bearing on the discovery of the prehistoric civilisation of the Indus Valley This discovery would never in almost any circumstances have been passed over as unimportant but the systematic examination of the site and its interpretation would have been far different and certainly less fruitful had it been made before instead of after the early excavations at Ur Archæologists indeed owe a deep debt of gratitude to those who have taken part in the work of the expedition with Dr Woolley at their head and to the institutions by which the joint expedition has been supported

Jubilee of the Society for the Study of Inebriety

THE fiftieth anniversary of the foundation of the Society for the Study of Inebriety and Drug Addiction and the centenary of the birth of its founder Dr Norman Kerr who died in 1899 were celebrated on April 10 by a luncheon held at the Langham Hotel at which the Minister of Health Lord D'Abernon the Bishop of Norwich Sir Thomas Barlow the presidents of the Royal College of Surgeons and of the Royal Society of Medicine and Sir Josiah Stamp were the principal guests The luncheon was followed by a commemoration address delivered by the president Sir Humphry Rolleston who gave a sketch of the life of the founder and the activities of the Society Norman Kerr who was the author of numerous works on various aspects of the alcohol problem regarded inebriety as a disease essentially allied to insanity and insisted that it should be treated medically and not as if it were a crime. It was mainly due to him that the Habitual Drunkards Act of 1888 and the Inebriates Act of 1898 were amended. During the fifty years of its existence, the subjects discussed by the Society have included the influence of heredity on alcoholism, alcoholism and child welfare, alcoholism and venereal disease, the use of alcohol in medicine, drug addiction as an international problem, ether-drinking and the cigarette habit. The Society, which consists of medical members and lay associates, aims at a scientific study of alcoholism and drug addiction and has not a policy of total abstinence.

Society of Dyers and Colourists

ARRANGEMENTS for the jubilee celebrations of the Society of Dyers and Colourists, to be held at Bradford at Whitsuntide, are in active progress. Inaugurated at a meeting in Bradford on May 14, 1884, the Society is the oldest of its kind in Great Britain. Special interest in the celebrations will be attached to the issue early next month of a jubilee number of the Society's *Journal* containing original articles by eminent authorities on the processes of dyeing and their development in the course of the past fifty years. In these, invention, scientific research and records of practical applications will receive full attention. It may be recalled here that the Society allots the Perkin Gold Medal at intervals, for conspicuous service to the tinctorial industries. By means of its award the synthesis of indigo, the discovery of viscose, of primuline, and of alizarine blue have been severally recognised.

Geistige Arbeit

THE object of a new periodical of this title which appears twice monthly (25 pfennigs per copy) is to give brief reviews of the progress and tendencies of modern scientific research. The subjects considered cover a wide field, including anthropology, political economy, agriculture, sociology and all the pure and applied sciences. There are articles on peasants and nomads, problems of German sociology, new concepts of natural science, methods of counting for statistical purposes, Paracelsus (a sketch), and many others. The contributors are chosen from the ranks of those who have done original work in their respective fields. In the article by Möglich dealing with the foundations of present day physics, we find due acknowledgment paid to the epoch making ideas of Planck and Heisenberg, but there are important omissions which detract from the value of the account. In highly compressed articles of this type, it is of primary importance that the authors should have not only a deep insight into their subjects but also a proper sense of values, if the services of a discriminating censor are not to be invoked. Goethe has said: "Die Vernunft ist auf das Werdende, der Verstand auf das Gewordene angewiesen." This remark applies particularly aptly to the present journal, which bears the sub-title "Zentralblatt für die gelehrte Welt". The article on Theophrastus Bombastus von Hohenheim, commonly called Paracelsus, is of interest as his name has recently come into prominence again as one of the first great experimenters in medical science—one hears of a Paracelsus Renaissance in Germany—in spite of a certain notoriety as a vagabond miracle worker which he probably only partly deserved. His ideas, if not actual results obtained, undoubtedly exerted a considerable influence on later workers. The journal is published by Walter de Gruyter and Co., Berlin W 10, Genthinerstr. 38.

Philosophy of Science

THE welcome co-operation between science and philosophy, which has become a distinctive feature of our time, is further illustrated by the appearance of a new quarterly *Philosophy of Science* which is published by the Philosophy of Science Association in the United States (Baltimore: Williams and Wilkins Co.; London: Baillière, Tindall and Cox. 6s. 9d.). This interesting publication sets itself the useful task of giving an organised expression to the growing interest among philosophers and scientific workers in classifying, and perhaps unifying, the programmes, methods and results of the disciplines of philosophy and of science. With this object in view the editor, Prof. W. M. Malisoff, proposes as a research programme the analysis of meaning, symbolism, definition, axioms and postulates, the study of the nature and formulation of theoretical principles, and questions of method and of the structure and hierarchy of the sciences. The first issue of the new journal contains a remarkable series of papers; among the contributors are Prof. J. B. S. Haldane on "Quantum Mechanics as a Basis for Philosophy", D. J. Struik on "The Foundations of the Theory of Probabilities", Rudolf Carnap on "The Character of Philosophic Problems". The excellent presentation of the journal and the eminence of its contributors give an added value to its object and method which, no doubt, will appeal equally to scientific workers and to philosophers.

Research in the Solomon Islands

A REPORT on the work of the Templeton Crocker Expedition to the Solomon Islands, 1933, has recently been sent to NATURE by the Director of the Bernice P. Bishop Museum, Honolulu. The expedition left San Francisco on March 2, 1933, in Mr. Templeton Crocker's auxiliary schooner *Vaca* and returned on September 15 after conducting a preliminary ethnographical and medical survey of a number of islands in the Solomon group. The principal objective was the Rennell and Bellona islands, but before arriving there the expedition collected data bearing on tuberculosis and tropical diseases, as well as ethnographical material, at Sikiana, Tulalagi, Guadalcanar and Malaita. Advantage was taken of conditions on Rennell and Bellona, where bird and insect life are undisturbed and the inhabitants virtually unaffected by European contacts, to make extensive collections of birds, plants and insects and to record particulars relating to native life and customs, which appear to have suffered little change since the Polynesian ancestors of the inhabitants first arrived there twenty generations ago. It was also possible to arrange for an intensive study of the disease and general health of the population of one district. Blood samples for filaria tests and blood groups were obtained. On Bellona the party was fortunate enough to obtain cinematograph record of the annual first fruits ceremony. A medical and health survey was also made on the islands of San Cristobal, Santa Anna and Santa Catalina. As a result of the expedition's work, 3,200 artefacts have been added to the collections of the museum in Honolulu [illegible] as a large number of entomological and botanical specimens. Other collections are to be distributed among scientific institutions in America and Europe, while the material relating to canoes will be submitted to Dr. A. C. Haddon in Cambridge.

Regulations Concerning Chemicals

ACTS of Parliament and Statutory Rules and Orders affecting the chemical industry are sufficiently numerous and complex to require documentation in a convenient and easily accessible form. That task has been undertaken by the Association of British Chemical Manufacturers, which in January 1931 published an index of such information. The third supplement, covering acts, rules and orders which have come to the notice of the Association during 1933 has recently been issued (Heffer, Cambridge, 6*d.* post free). New regulations regarding the packing and stowing of dangerous goods in ships have been made, and a revised edition of the summary of the principal regulations made under the Explosives Act has been issued. Reference is made to the Spirits Act, 1880, and the Still Licence Act, 1849. All plant capable of being used as a still is subject to licence, but exemptions are granted in respect of alkali works, coal gas, tar distillation, solvent recovery, chemical experiments, professional chemists, etc. Water stills of more than 1 gallon capacity require a licence; otherwise exemption may be granted on application. The supplementary index also refers, *inter alia*, to the Dyestuffs (Import Regulation) Act, the Import Duties Act, the Ottawa Agreements Act, the Poisons and Pharmacy Act, and the Safeguarding of Industries Act.

Graph Papers

WE have received from Messrs. Wightman Mountain, Ltd., of Artillery House, Victoria Street, Westminster, some samples of graph paper. These are of considerable interest as exhibiting the great range and variety of papers now produced in England. Of squared papers alone, Messrs. Wightman Mountain list more than 250 sizes and styles, some with ruled and others with engraved lines. A wide range of logarithmic papers includes, for example, sheets covering the ranges 7–400 and 1–10,000. Profile paper is specially ruled for making longitudinal sections of railways, roads, etc. Other varieties of graph paper include permille paper (arithmetic probability), square law, polar, isocandle, triangular and isometric papers. A new paper is one ruled in tenths of an inch one way and in inches and twelfths the other. The increasing demand for the graphical presentation of commercial data has led to the publication of a number of data sheets, including daily, weekly and monthly progress sheets. Even a holiday chart is not lacking. To furnish some idea of the papers available, the firm is offering for half a crown a special sample packet of 58 different data sheets.

International Agricultural Congress in Budapest

THE International Congress of Agriculture is meeting this year in Budapest on June 13–20. The Congress is held every two years in a different European capital and is attended by delegates from some thirty countries who represent every side of agricultural life. The work of the Congress is divided into eight sections. The first deals with economics and agrarian policy, world prices, the organisation of markets and the economic consequences of mechanisation. Two other sections, those on co-operation and agricultural industries, occupy parts of the same field, and the section dealing with viticulture will this year be economic rather than technical. Two sections treat respectively of animal and vegetable production from the scientific side. Modern horse breeding, the influence of pasture on the quality of milk, contagious abortion, the production of forage crops under semi-desert conditions, plant selection, the classification of wheats and the improvement of alkaline soils are the principal subjects for discussion at Budapest. The remaining sections are to some extent social in scope, dealing with agricultural instruction and the position of women in rural communities. The Congress will be accompanied by social functions and followed by excursions, which will enable delegates to see something of educational and scientific work in connexion with Hungarian agriculture, as well as of Hungarian farming and peasant life. It is expected that a party of British delegates, connected either with agricultural science or with bodies such as the National Federation of Women's Institutes, will take part. Further information can be obtained from the secretary of the British Corresponding Committee, International Congress of Agriculture, 10 Doughty Street, London, W.C.1.

Announcements

PROF. J. C. MCLENNAN will deliver the twenty-fifth Kelvin Lecture before the Institution of Electrical Engineers on April 26, taking as his subject "Electrical Phenomena at Extremely Low Temperatures". Before the lecture, the Faraday Medal of the Institution will be presented to Sir Frank Smith.

DR. C. E. KENNETH MEES, director of research to the Eastman Kodak Co., Rochester, U.S.A., will deliver the Sir Henry Trueman Wood Memorial Lecture before the Royal Society of Arts on May 16. The subject of Dr. Mees's lecture will be "Some Photographic Aspects of Sound Recording".

A DINNER in honour of Prof. Karl Pearson will be held at University College, London, on April 23, when a portrait plaque in bronze of Prof. Pearson will be presented to the College on behalf of subscribers to the Karl Pearson Commemoration Fund. A Brunsviga calculating machine has already been handed over to Prof. Pearson and a duplicate of the plaque will be given to him at the dinner.

THE Gold Medal of the Institution of Mining and Metallurgy, the highest distinction in its power to confer, has been awarded to Mr. John A. Agnew, in recognition of his services in the development of the mineral resources of the Empire, and to the mining industry. The following awards have also been made by the Council of the Institution: The Consolidated Gold Fields of South Africa Ltd. Gold Medal and premium of forty guineas to Dr. W. R. Jones, for his researches on the incidence of silicosis, and for his published papers on the subject; William Frecheville Student's Prize of ten guineas to Mr. D. J. Rogers, for his "Notes on a Tunnel driven at Stan Trg Mine, Yugoslavia"; two grants from the Post-graduate Grants Fund to enable the recipients to pursue their geological studies in Spain.

MR. K. F. TOMS, late assistant superintendent of plantations, East African Agricultural Research Station, Amani, has been appointed by the Secretary of State for the Colonies to be agricultural and forestry officer, St. Helena.

AT the stratosphere conference, which closed in Leningrad a few days ago, it was decided to call a world conference for the study of the stratosphere in the U.S.S.R. in 1936. The time of the conference is to coincide with the eclipse of the sun on June 19 of that year.

THE applications of photography to map making are steadily widening. The fourth International Congress of Photogrammetry will be held in Paris on November 16–December 2 this year. There will be an exhibition of materials and apparatus relevant to the Congress at the same time. Inquiries should be addressed to M. le Président, Commission 2, Congrès International de Photogrammetrie, 4 Rue Galilée, Paris 16 e.

THE Rome correspondent of the *Times* reports that Commendatore Renato Donati on April 11 at the airport of Montecelio broke the world's altitude record for aeroplanes of any type when he reached a height of 14,500 metres. Signor Donati was flying a specially constructed Caproni 114 h.p. biplane.

AT the meeting of the London Mathematical Society to be held on Thursday, April 26, at 5 p.m. in the rooms of the Royal Astronomical Society, Burlington House, W.1, there will be discussion on "Integral Functions". Prof. E. C. Titchmarsh will introduce the subject, Dr. E. C. Collingwood will speak on "Properties of Exceptional Values of Integral and Meromorphic Functions", Miss M. L. Cartwright on "Directions of Borel of Integral Functions and their Relation to the Singularities of Power Series", and Prof. J. M. Whittaker on "Difference Properties of Integral and Meromorphic Functions".

WE have received a volume of Abridged Scientific Publications from the Kodak Research Laboratories, vol. 15, 1931–32, published by the Eastman Kodak Company, Rochester, New York. This volume comprises abridgments of 61 papers, most of which are accounts of original researches on subjects related to photography.

THE Ministry of Agriculture has recently issued a portfolio of "Leaflets on Insect Pests of Farm and Garden Crops" which is intended to replace sectional vol. 11 on the same subject. The advantage of the present portfolio over the bound sectional volume is that it enables all new and revised leaflets to be inserted and the portfolio is thus kept up to date. The portfolio of leaflets is obtainable price 1*s*. 6*d*. net through any bookseller. Readers who wish to receive copies of new or revised leaflets may do so on payment of a nominal registration fee; full particulars of this scheme may be obtained by writing to the Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A technical officer (Grade II) in the Directorate of Technical Development, Air Ministry—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (April 23). A lecturer in educational psychology at the Maria Grey Training College, Salusbury Road, London, N.W.6—The Principal (April 24). Three male junior assistants (temporary) at the Experimental Research Station, Porton, Wiltshire—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, S.W.1 (April 28). A demonstrator in biochemistry in the School of Biochemistry, University of Cambridge—Sir F. G. Hopkins, Sir William Dunn Institute, Tennis Court Road, Cambridge (May 2). A temporary technical assistant in farm economics in the Department of Agriculture for Scotland—The Establishment Officer, Queen Street, Edinburgh, 2 (May 5). An assistant master to teach mathematics, mechanics and physics at the Polytechnic, Regent Street, London, W.1—The Director of Education (May 7). An assistant lecturer in botany at the University of Manchester—The Registrar (May 7). A chief inspector of explosives in India—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (May 10). An assistant lecturer in zoology at the University of Bristol—The Registrar (May 11). A lecturer in zoology at Bedford College for Women, Regent's Park, N.W.1—The Secretary (May 22). A fuel technologist in the Public Service Board of New South Wales—The Official Representative of the Government of New South Wales, Wellington House, 125, Strand, London, W.C.2 (May 31). A member of the vocational guidance staff at the National Institute of Industrial Psychology, Aldwych House, London, W.C.2—The Secretary.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Co-ordination of State Scientific Services

THE editorial article on "Co-ordination of the State Scientific Services" in NATURE of February 10 comments upon various statements made in "Patriotism Ltd."

For example, the article states that since the War period, the D.S.I.R. and the M.R.C. have not undertaken or financed any work for 'purely warlike purposes' and implies that 'purely industrial or medical motives' have been the primary aim in all their investigations. Furthermore, the article states: —

"It would be equally indefensible if work undertaken at the instigations of the fighting services but not specially paid for by contributions from their vote were not published and made available for use in industry."

In the case of the following three investigations carried out by the Medical Research Council, reports were sent only to departments of the fighting services and were not published:

(1) The Council investigated a problem of direct importance to chemical warfare, namely the limiting of the visual field for different types of respirators. This investigation was carried out at the request of the Chemical Defence Research Department and the results were reported to that Department only.

(2) The Industrial Health Research Board investigated "the personal factors in proficiency for naval gunnery". Is it seriously maintained that this has an industrial application?

(3) The same Board, at the request of the Admiralty, investigated the psychological factors in deep sea diving and sent its report to the Admiralty.

In all these cases the investigations appear to have been financed by the M.R.C., yet the reports are not recorded as having been published.

The M.R.C. investigations into rifle shooting were reported to the War Office and no report seems to have been given to the general public. It is incorrect to suggest that the Council has drawn on the special acoustical knowledge of the fighting services primarily to assist in the alleviation of deafness, since it undertook "at the request of the War Office" investigations into the selection and training of anti-aircraft listeners. These investigations were reported as being continued in the M.R.C. Annual Report for 1931–32, but all reference to them is omitted from the Report for 1932–33.

In view of these facts and of many similar ones published in 'Patriotism Ltd.', we must conclude that a considerable amount of assistance has been given to the fighting services by these committees. We agree that in practically all branches of science, under the control of these committees, new knowledge is adaptable to the purposes of military science. It seems, however, to be indisputable that such adaptation is the proper function of the soldier and of his scientist servants. It is known that there have been certain resignations and a protest against this employment for warlike purposes of presumably neutral scientists' time and energy.

The statement made by the president of the Royal Society that scientific men "are now in real control of scientific policy in Great Britain" greatly clarifies the position. As you valuably state, further militarisation of these research committees can take place only with the scientists' "connivance and responsibility".

DOROTHY WOODMAN.

Union of Democratic Control,
34, Victoria Street,
London, S.W.1.
March 15.

"PATRIOTISM LTD.: an Exposure of the War Machine" is published by the Union of Democratic Control, and Chap. 5, entitled "The Science of Murder", is intended to show how such organisations as the Department of Scientific and Industrial Research, the various industrial research associations, the Medical Research Council and the Industrial Health Research Board, "are perverted to the uses of death". The main contention is that research is carried out for the fighting services by these bodies though their financial resources are budgeted for in the civil estimates. After an inquiry into the facts, these and related allegations were dealt with in the article in NATURE to which Miss Woodman refers. When the article appeared, we received a long communication in which an attempt was made to justify the statements in "Patriotism Ltd.", but we could not possibly find space for it, and therefore we asked Miss Woodman to limit herself to specific examples of the diversion of financial provision for civil research to work for the fighting services. The above letter is the result, and the very triviality of the cases cited is almost enough to condemn the main thesis.

It is scarcely worth while to traverse the arguments again, but in any government department concerned with scientific research it may be taken for granted that: (1) Its financial resources will not be available for work which should be paid for by another department. (2) If work is done at the suggestion of another department, or with facilities given by it, a report is usually transmitted to the department. (3) If the results are not published, this is not because of any seal of secrecy but because they are incomplete or not of sufficient scientific value to be published.

As to the particular investigations mentioned by Miss Woodman, we suggest that if the Union of Democratic Control had desired to know the truth concerning them it would have communicated with the Medical Research Council instead of construing for itself isolated sentences in reports. We have inquired into these cases, and have satisfied ourselves that the facts are as follows:

1. The Physiology of Vision Committee of the M.R.C. was consulted on the effect of respirators on the visual field. The only work done on the subject was undertaken by a member of the Committee who is an officer of the R.A.M.C., as stated in the Annual Report of the M.R.C., and as he was giving whole-time service to the War Office, the M.R.C. was not involved in any expenditure. Any knowledge gained by the committee remains, however, available when advice is asked as regards respirators used in dangerous industries, mine rescue work and the like.

2. It is certainly maintained that the investigation of the personal factors in proficiency for naval gunnery has an industrial application. It formed part of a larger investigation into the general problem of vocational selection. Many of the opportunities

for this work have been found in the Services where it is possible to examine a controlled personnel and to obtain at a later date reliable records of their after histories Few of the results have yet been published but all are available for publication eventually when enough evidence has been accumulated

3 The main part of the work on deep diving done by the M R C was on the fundamental question of the saturation of the tissues with gaseous nitrogen The report on this work forwarded to the Admiralty consisted of three sections each of which has since appeared in the *Quarterly Journal of Experimental Physiology* The work done on the psychological side occupied only a very small fraction of the time and as nothing of importance emerged from it no report has yet been published though the knowledge gained is available to anyone inquiring about deep diving from a civilian point of view

4 The investigation of rifle shooting was not undertaken at the request of the military authorities but at the instance of an academic psychologist who happened to see in the operation an interesting combination of manual visual and psychological factors The results have not been published, but they are being prepared for publication The War Office was sent a report as a matter of courtesy

5 In the matter of the selection and training of anti aircraft listeners the actual investigations made by the M R C have taken the form of fundamental research into questions of aural localisation and the results have been or are being published

We need scarcely say that no further space can be afforded in these columns for a discussion of the questions raised by the Union of Democratic Control as to the use made by the fighting services of civil research organisations

EDITOR OF NATURE

Proportion of Heavy Water in Natural Water

IT has been suggested that the proportion of heavy water in natural waters may vary according to their source It is, however, unlikely that any considerable variations occur

Consider for example, the Dead Sea We may suppose that the rate of influx of water into the Dead Sea is equal to the rate of loss by evaporation In a case like this a steady state will eventually be reached—and in the case of the Dead Sea, presumably has been reached—such that the proportion of heavy water in it remains constant with time At the steady state, the composition of the inflowing water is the same as that of the water vapour evaporating away So the Dead Sea is in equilibrium with water vapour of the same composition as the inflowing water, and, in consequence, it contains but a very slightly greater concentration of heavy water than the inflowing water In fact, the excess is no more than would be gained by a single distillation at a pressure equal to the vapour pressure of the Dead Sea—a negligibly small amount

This argument assumes that the inflowing water is at once distributed evenly throughout the whole of the Dead Sea Imperfect mixing will permit of a greater concentration of heavy water, but it is unlikely even then that there is any remarkable concentration of heavy water in water from any natural source We may take it, then, that natural waters contain a sensibly constant concentration of heavy water, or, to speak more cautiously that the processes of evaporation and condensation in Nature are unlikely to produce any considerable separation of the two kinds of water

H A C McKAY

33 New Road
Croxley Green
Herts
March 27

IN connexion with the foregoing letter some results may be quoted of an examination of Dead Sea water carried out in this laboratory by Dr A F Martin

The Dead Sea water was obtained by the kindness of Palestine Potash Ltd and consisted of samples taken from near the surface and at a depth of 53 metres below the surface

These samples were distilled and in addition the salts remaining after ordinary distillation were reduced to dryness by the application of heat, but none of the distillates was found to be heavier than ordinary pure distilled water prepared in the laboratory

To determine the density, a spherical mass of silica attached to the beam of the balance by a fine silica fibre was weighed in the various samples of water and the greatest difference in density between distilled water and distilled Dead Sea water was 0 00003 the uncertainty of measurement being about 0 00002

It does not appear therefore that there is any notable proportion of heavy water in the Dead Sea

R ROBERTSON

Government Laboratory
Clement s Inn Passage
Strand, London W C 2
March 29

Spectrum of the HD- and D_2-Molecules

WE have photographed the molecular spectrum of hydrogen under high dispersion and obtained a series of photographs of samples with increasing amounts of the heavy isotope ranging from pure H_2 to practically pure D_2 We are indebted to Prof H S Taylor of Princeton for the heavy hydrogen In this way it was possible to decide unambiguously whether a line is due to H_2 HD or D_2 It is well known that a considerable part of the H_2 spectrum was analysed chiefly through the efforts of O W Richardson and his co workers but there remains a great number of problems concerned with the analysis and interpretation of this complicated spectrum The main purpose of the present investigation is to obtain additional material which can be used for a further analysis of the molecular spectrum of hydrogen and to help to clear up doubtful points in its interpretation We are confident that in this way our knowledge of the structure of the hydrogen molecule can be greatly increased

The comparison of the three spectra gives indeed a vast amount of interesting information for which we must however refer to the full account of the work which is to appear elsewhere We wish to give here only some of the results of the analysis of the bands of HD and D_2 which are analogous to the Fulcher bands of H_2 These bands have a relatively simple structure and do not show markedly the decoupling effects which are so characteristic of most other hydrogen bands Therefore most of the results of the analysis can be summarised by a table of the band constants

	1 H_2	2 HD	3 D_2	*Ratio* 1 2	 1 3	ρ^n_{12}	ρ^n_{13}	n
ω	2373 18	2055 52	1678 70	0 866 15	0 707 37	0 866 17	0 707 44	1
ω''	2665 34	2308 39	1885 80	0 866 08	0 707 53			
ωx	66 32	49 68	32 90	0 7490	0 4960	0 7502	0 5005	2
$\omega x''$	72·09	53 73	35 93	0 7454	0 4985			
B''	34 216	25 685	17 109	0 7507	0 5000			
α''	1 671	1 099	0 606	0 658	0 363	0 650	0 354	3
D''	0 0216	0 0128	0·0055	0 59	0 25	0 563	0 250	4

In this table the chief constants which occur in the expression

$$W/hc = \omega v - \omega x v^2 + \quad + B(1 \quad \alpha v)J(J+1) - DJ^2(J+1)^2 +$$

$(v = \frac{1}{2}, 1\frac{1}{2}, \quad , J = 0\ 1, 2, \quad)$ for the vibrational and rotational energy are given for the upper and lower states of the three different hydrogen molecules The values for H_2 are taken from the work of Richardson and Das[1] The columns marked '*Ratio* give the ratio of the constants of HD and D_2 to the corresponding values for H_2 The next two columns give the theoretical values to which these ratios should be equal These are found from the known[2] values of the reduced masses μ_i by the relations $\rho^2_{ij} = \frac{\mu_i}{\mu_j}$

It is seen that the agreement between the theoretical and experimental ratios is very satisfactory We are confident that the remaining discrepancies are entirely due to experimental errors which arise chiefly from the fact that an inadequate formula is used for the calculation of the constants (We included terms up to the fourth power in v and to the sixth power in J) The agreement can be materially improved by an adjustment of the constants without impairing the accuracy with which the observed wave numbers are represented by the formulæ We prefer, however, to give here the constants which were calculated without bias in the usual way for each molecule separately The table then shows to what accuracy the calculated values for band constants of this type in general can be expected to agree with the theoretical values The fact that a given formula represents well the experimental data is very often insufficient to judge this point

We find that there is a discrepancy of about 2 6 cm^{-1} between the values of the electronic frequencies This seems too large to be attributed entirely to experimental errors We wish to suspend our judgment about this, however, until all the constants have been recalculated in a way which takes more rigorously into account all the various relations between them

The component of the initial $^1\Pi$ state which gives the P and R branches shows perturbations for all three molecules The type of perturbation is the same, and is most easily recognised by the anomalous values of the Λ doubling The details, however, differ considerably While, for example, in H_2 the state with $v = 1$ is most strongly affected, it is quite regular for HD, but for this molecule the $v' = 0$ level is very irregular This behaviour can be understood from the fact that the relative positions of the perturbing and the perturbed vibrational levels are slightly shifted in the three different molecules due to the anharmonic character of the binding

Richardson and Das noticed that in H_2 all P- and R branches are absent for $v' > 4$ This is also true for HD, but in D_2 the P and R branches are normal for $v' = 4$ whereas they are absent for $v' > 5$ We can understand this behaviour if we attribute the disappearance of these branches to predissociation The predissociation limit, which is determined entirely by the shape of the potential curves, is independent of the nuclear masses, and while it is surpassed by four vibrational quanta of H_2 and HD, four of the smaller vibrational quanta of D_2 will fall below it, but five will also surpass it for this molecule From these observed facts we can derive that the predissociation limit must lie between 0 93 and 1 02 volts above the electronic frequency of the $^1\Pi$ state

G H DIEKE
R W BLUE

Johns Hopkins University,
Baltimore
March 7

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[1] *Proc Roy Soc* A 122 688, 1929

[2] Bainbridge *Phys Rev* 44 57 1933

Activities of Life and the Second Law of Thermodynamics

I AM anxious to treat Prof Donnan's views with all courtesy, but think his last letter, written in conjunction with Prof Guggenheim, is entirely invalidated, like his previous letter, by a technical error in thermodynamics

The ordinary formula for the positional entropy of a large number of particles is

$$-k \iiint \nu \log \nu \, dx\, dy\, dz$$

where ν is the number of particles per unit volume Thus moving N particles from a place of density ν to one of higher density ν' decreases the entropy by

$$kN(\log \nu' - \log \nu)$$

Surely Profs Donnan and Guggenheim have overlooked the factor N Owing to its presence, moving a single molecule does not, as they contend, have the same effect as moving a truckload of N molecules, but only $1/N$th of this effect The same error, I think, invalidates their second paragraph

It is difficult to discuss views based on arguments which seem to me so entirely fallacious, so I can only repeat that I think the writers are in error by more than mere technical mistakes They seem to me to be comparing two things that do not enter into relation with one another at all—like the number of calories in a man's dinner, and the number of ergs needed to carry it in from the kitchen to the dining room

As they ask for a physiological reference, may I (although no physiologist) refer them to Carnegie Institution Publication, No 446 ("Mental Effort", by F G and C G Benedict, 1934) ?

J H JEANS

Cleveland Lodge,
Dorking

Periodic Structure in Ice

A CONCAVE metal vessel, 5 cm × 3 75 cm × 1 2 cm at its deepest point, resting in natural contact (that is, at greatest convexity of its convex surface) with a stone pavement, became filled with rain water or melted sleet It remained overnight, and held next morning a plano convex lens of ice, which exhibited a beautiful periodic structure

The periodic structure consisted of about a dozen very distinct colourless concentric circles, 0 5–1 mm radial variation, the least, central, one about 1 cm diameter, with transparent ice between the rings The structure persisted through the depth of the lens, the largest circle being, of course, of least depth A small piece of black foreign matter (perhaps a smut) which may, or may not, have had something to do with the formation of the structure, was frozen into the centre of the smallest circle

In reporting a previous observation of periodic structures in carbon films due to oil drops[1], the absence of colloids, chemical action and dissolution was stressed But in this present observation, which also is probably original, one chemical substance alone appears to be concerned There is, of course, the possibility of 'heavy' water and of two phases—solid and liquid—being concerned, though the ring structures seemed as solid as the clear ice The original liquid might also have contained a slight amount of dissolved impurity, if only condensation nuclei Attempts will be made, artificially, to reproduce such periodic structures in ice

S C BLACKTIN

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March 15

[1] NATURE 129 401 March 12 1932

Loss of Mass in Binary Systems

SOME years ago, Sir James Jeans[1] considered the problem of the variation in the orbital elements of a binary star in which one or both of the components is losing mass by radiation He concluded that, in these circumstances, the orbital eccentricity will remain constant, whereas the semi axis major varies inversely as the sum of the masses of the components

Shortly after, Prof E W Brown[2] discussed the same problem from a different point of view, arriving at the conclusion that the orbital eccentricity varies inversely as the sum of the masses, while the semi-axis increases at a still higher rate His paper was criticised by Jeans[3], but the cause of their fundamental disagreement was not then, nor has since, been cleared up

An investigation which has recently been completed throws light on this difficulty Starting from the equations of motion in Cartesian form as given by Jeans, the differential equation of the orbit is deduced, and its general solution obtained It is found that Jeans's result is justified, and the source of Brown's error is explained

The *main* result *of the investigation is* that the loss of mass through radiation leads to the relation, ***semi-axis major is inversely proportional to the mass of the system***, which holds throughout the life of the binary, or alternatively,

$$P/a^2 = \text{constant},$$

that is, $\log P - 2 \log a'' + 2 \log \pi'' = \text{constant}$ in the usual notation

A statistical study of all the available material for the visual binaries has shown that not only does this relation hold throughout the life of any one star, but also it holds statistically at the present epoch for all visual binaries in the form

$$\log P - 2 \log a'' + 2 \log \pi'' = -0\ 826 \pm 0\ 098$$

This result shows that all such binaries apparently originate with nearly equal values of the quantity P/a^2, the degree of scatter of individual values from the mean being given by the probable error 0 098 of the constant 0 826

This relation leads to a form of hypothetical parallax which we may call the mass radiation parallax, and which has been computed for 123 binaries the orbital data of which can be taken as well determined The computed values are found to agree very well with those found on the basis of other methods

The above relation does not appear to hold for the eclipsing or the short period spectroscopic binaries The reason for this difference between the short and the long period binaries is probably bound up with the difference in origin of these two groups, but as yet no adequate explanation of the observations has been forthcoming

A E H BLEKSLEY

University of the Witwatersrand,
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Feb 18

[1] *Mon Not Roy Ast Soc* 85, 2 1924
[2] *Proc Nat Acad Sci*, 11 274 1925
[3] *Mon Not Roy Ast Soc* 85 912 1925

Calcium Isotope with Mass 41 and the Radioactive Half-period of Potassium

THE values given in a previous note[1] for the radio active half period of the potassium isotope with mass 41, as derived from the abnormality in the atomic weight of calcium extracted from Rhiconich and Portsoy pegmatites, stand in need of correction

In the first place, it has been learned through the kindness of Prof Arthur Holmes, of the University of Durham to whom a sample of the Rhiconich rock had been sent, that the Geological Survey analysis of this pegmatite[2] was not applicable to the material actually used, which had not been hand picked Independent analysis conducted by Dr Winifred Guthrie in this laboratory and by Dr A W Groves of the Royal College of Science agreed in assigning to this material a CaO content of 0 55 per cent (instead of 0 27) and K_2O content of 8 0 per cent (instead of 9 35)

The Portsoy pegmatite, which had been hand picked, gave analyses much closer to the Geological Survey figures, namely, CaO 0 28 per cent (exact agreement) and K_2O 8 0 per cent (instead of 8 9) The age of 600 million years assumed for this rock in our previous note, however, is decidedly higher than geological evidence warrants, and a value of 400 million years may be regarded as more reasonable

While the necessary recalculations were being made in the light of the above changes, it transpired that an unsuspected constant error had entered into our earlier calculations and that the life periods arrived at were accordingly all too high The final values for the half period of the potassium isotope with mass 41 now obtained are (*a*) under the assumption that all the calcium with mass 41 was extracted, $1\ 6 \times 10^{11}$ years

(*b*) under the assumption that only one third was extracted $0\ 5 \times 10^{11}$ years

The Rhiconich and Portsoy rocks give identical figures, and the value indicated is of the order 1×10^{11} years which is in accordance with the revised results of Holmes and Lawson, *not* with the more recent work of Muhlhoff[3]

JAMES KENDALL
WILLIAM W SMITH
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April 4

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[1] NATURE 131 688 May 13 1933

[2] Geological Survey Summary of Progress for 1919 pp 43–4

[3] *Ann Rep Chem Soc* 27, 310–11, 1930

The Helmholtz Resonance Theory of Hearing

DIRECT evidence in favour of the view that the vibrating elements of the cochlea are differentially tuned for frequency has been adduced in the following way

The cochlea of the cat is exposed under Nembutal anaesthesia Viewing the preparation through a dissecting microscope, and using a dental burr, small excavations are now made in the bone, one proximal to the round window, the other towards the apex of the cochlea, the floor of these concavities may be made so thin that the cochlear fluids seep through, a state of affairs which may be easily seen through the microscope At this juncture, small beads of mercury are placed in the depressions, using a micro pipette, in this way further loss of fluid is prevented, and a good electrical contact with the fluids of the inner ear established, by the insertion of platinum electrodes into the mercury droplets

In response to sound stimuli, potentials are engendered between these electrodes and an indifferent electrode placed beneath the mylo hyoid muscle (Wever and Bray effect), and these may be recorded by means of an amplifier and oscillograph

The amplitude of the potentials in response to a note of 250 cycles has been found to be three or more times as great at the apex as at the base, while a note of 2,050 cycles gives rise to potentials of amplitude some four times greater at the base than at the apex

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March 27

The Attitude of the German Government towards Science

IN spite of my letter in NATURE of February 24, there still seems to exist in English scientific circles a misunderstanding of the attitude of the new Government in Germany towards science and of the reasons why Jewish scientists have left the country May I be allowed therefore to point out the following facts ?

It must be emphasised once more that it is far from the thought of the National Socialist Government to make an attack on the freedom of scientific investigation, rather is it anxious to give scientific persons every possible help for their work I have myself on many occasions been asked by the National Socialist Ministers to join them in assisting individual scientific persons and institutes

The National Socialist Government has not subjected Jewish scientists to exceptional treatment, or forced them to emigrate it has passed a law for the reform of the Civil Service which applies to all kinds of officials, not only to those concerned with science According to this law, non Aryan officials were obliged to leave their positions if they were not appointed before 1914, or if they had not fought at the front in the War, or had not lost fathers or sons in the War No Government can be denied the right to make such rules in the interests of its own people, and no group of officials, for example, scientific ones can be made an exception to such a general law As a matter of fact however, in a number of individual cases an exception was made to the advantage of Jewish scientists

Various Jewish scientists, without being forced to do so, have given up their professorships and moved to other countries This they have done, as some of them have declared openly, out of sympathy with their Jewish kinsfolk who were affected by the law This attitude can be understood and appreciated One should not, however, set them up outside Germany as martyrs of unjust treatment by National Socialist Germany, nor quote them as signs of the denial of intellectual freedom in Germany This would be a misunderstanding of the actual position

The withholding of criticism of the new regime in Germany, or at least a conscientious regard for the truth in scientific circles will be to the advantage not only of international co operation but also of the Jewish scientists themselves

With regard to the assertions and opinions of my respected colleague, Prof A V Hill, on the above mentioned matter I should like to invite him to visit Germany and as a scientific investigator to get acquainted with the actual facts by means of his own observation and collection of evidence

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Ancient Houses of North Rona

IN a short notice of a book on Ronay[1], the reviewer refers to the curious remains of dwelling houses on North Rona and likens them (from the description) to the dolmen of Locmariaquer and Carnac In the latter part of October 1928, in the course of making a census of the grey seals of Scotland during the breeding season, on behalf of the Scottish Office, W L Calderwood and I landed on this island, seldom visited by naturalists or archaeologists The salient characteristics of the houses, which seem to have been inhabited in recent historic times, are that they are half sunk in the ground, have a low wall of dry stone construction rising above the surface, which probably carried a wooden roof made water tight by turves, and were entered not directly, but through a low and generally curved, roofed passage, along which the entrant had to crawl

So far as I know, no suggestion has been made, other than the reviewer's, as to the origin of such a construction, and I write to direct attention to the possibility that they may indicate Eskimo influence or perhaps even a former Eskimo habitation of the island During excavations which revealed ancient Eskimo culture on the long since deserted island of Punuk off St Lawrence in north western Alaska Henry B Collins of the U S National Museum discovered ruined houses of the historic period which bear close resemblance to the houses of North Rona There is the same subterranean construction low walls carrying a low roof and an entrance by way of a long narrow tunnel The chief difference is in the building material for the Punuk houses are constructed of a framework of driftwood logs and the bones of whales apparently jaw bones and ribs[2]

There is no reason why North Rona lying forty miles north of the Scottish mainland might not at some early period have been colonised by Eskimos But there is the other possibility that the peculiar conditions of exposed wind swept islands lacking protective vegetation may have led to the independent development of this curious type of hut in these distant places Something of the same kind has been revealed in the excavations supervised by Prof Gordon Childe at Skara Brae in the Orkney Isles

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NATURE 133 399 March 17 1934

[2] Explorations and Field work of the Smithsonian Institution in 1928 Washington 1929 p 148

Chromosome Differences in Mice Susceptible and Resistant to Cancer

COUNTS of chiasma frequency made at early mid and late diaphase of spermatogenesis have revealed a significant difference between two strains of mice one highly susceptible to spontaneous development of mammary carcinoma the other highly resistant The strains are respectively *A* and *CBA* obtained from Dr C C Little Roscoe B Jackson Memorial Laboratory Bar Harbor Maine

The mean number of chiasmata per cell is 28 44 in strain *A* and 33 12 in strain *CBA* The difference between them is 4 68 (with a standard error of 0 707) the necessary difference for P 0 01 is only 1 909 (Fisher Statistical Methods for Research Workers 3rd ed) The test for significance of the difference in distribution gave χ^2 54 93 as shown in the accompanying table the requirement for P = 0 01 is only 11 341

	Number of bivalents				
Number of chiasmata per bivalent	1	2	3	4	Total bivalents
Strain *A* (susceptible)	304	181	15	0	500
Strain *CBA* (resistant)	247	185	61	7	500
Total bivalents	551	366	76	7	1 000
χ^2 =	13 15	0 09	34 69	7 00	χ^2 = 54 93

The data have been obtained from two distinct studies in which different fixatives and slightly different methods of staining were used Twenty eight complete nuclei were analysed in the first test and twenty two in the second In each case these comprised equal numbers of nuclei at the same stages of meiosis from each strain They were from seven mice of comparable ages The results from the two studies were in complete agreement

These observations were made as a first test of a series of simple related working hypotheses on the mechanism of heritable susceptibility to cancer The hypotheses are based primarily on the somatic cell mutation theory of cancer and the discovery of genes and chromosome deficiencies affecting the mechanism of mitosis or meiosis[1] This first test of chiasma frequency is of course entirely indirect in its possible application to the cancer problem it hinges on the relationship of meiosis to mitosis[2] Though indirect the chiasma frequency test is on the hypotheses formulated of particular value since it provides a relatively precise *quantitative* measure of differences between sets of chromosomes other tests are in progress Until they are completed and other strains of mice tested for chiasma frequency it would be premature to discuss the possible significance of these data for the cancer problem They are in striking accord with expectation on the basis of the particular hypothesis they were designed to test but the possibility of an unknown factor other than cancer susceptibility being involved has not yet been eliminated

Apart altogether from the cancer problem the results obviously have general cytogenetic significance

C LEONARD HUSKINS
E MARIE HEARNE

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March 3

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[1] Huskins C L and Hearne E M *J Roy Micro Soc* 53 109 1933

[2] Huskins C L NATURE 132 62 July 8 1933

International Status and Obligations of Science

IN NATURE of February 24 were published letters from Prof Stark and myself referring to dismissed German scholars and scientists I could not neglect the opportunity of saying that the Academic Assistance Council (Burlington House W 1) urgently needs funds Whether it was Prof Stark s eloquence or mine I am not sure (perhaps a little of each) but an unknown friend in America has written me referring to this correspondence and enclosing five cheques from members of his family to the amount of 230 dollars to be used for furthering this assistance He hopes to send a little more

His generous action will provide for one of our colleagues for several months but—will Prof Stark allow me to say ?—many still need help and there is next year and the year after before a limit to the problem can be seen and who can tell what may happen elsewhere ? This gift represents 0 2 per cent of what is still required for the next two years Will other readers of NATURE help with the remainder ?

A V HILL

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March 23

Research Items

Bronze Age Cephalotaphy in Wiltshire. Mr J F S Stone records in *Man* for March the discovery of a separate burial of a skull in the course of excavations of Beaker Folk dwelling pits surrounding the cluster of flint mine shafts on Easton Downs, Wilts Authenticated instances of the ancient burial rite of cephalotaphy are rare in England The barrow in which the discovery was made is small and low, being 23 ft in diameter and 2 ft high The body of the barrow was composed entirely of chalk rubble which had been extracted from the surrounding ditch The ditch was square in section, 2 ft 3 in wide and cut in the chalk to a depth of 16 in A shell filled band of humus containing numbers of well patinated flints to a depth of 8 inches overlay the primary chalk silting Very slightly north of central was found a comparatively large stone cist, 5 ft 6 in long, by 3 ft 2 in wide, cut into the chalk twelve inches below the original surface The total depth was 3 ft 8 in In the south west corner was an almost perfect skull, twelve inches from the west wall and seven from the south It lay on the left parietal and faced south, the skull base, therefore, being toward the west wall and thus precluding the possibility of any body having been attached to it at the time of burial The skull had been pillowed on six inches of chalk dust The atlas and axis were articulated in their normal position, but the lower jaw had been moved by rabbits to a distance two feet away The vertebræ fell away on the skull being removed, proving that it had not been moved since the flesh rotted away Propped against the vault of the skull, and erect on its broader end, was a roughly chipped bar of flint 9½ in long, 3½ in wide at the broader end, and averaging 2 in thick No dateable object was found, but various considerations suggest the Early Bronze Age Miss M L Tildesley reports on the skull, her conclusion being 'Early Bronze Age very probable, La Tène or Romano British possible, Anglo Saxon improbable"

Clan and Moiety Mr Ronald L Olson has made a study of the derivation of social organisations among the American Indians, which is published under the title Clan and Moiety in Native America" (*Univ California Pub Amer Archæol and Ethnol*, vol 33, No 4) Except among the Eskimo and in Patagonia, clans and moieties are found in every culture area in the two Americas In all those, except on the north west coast and in the California Great Basin, both maternal and paternal descent occur, while the dual grouping and the multiple type are also found, sometimes singly, sometimes co existing Probably three fourths of the area of the Americas was occupied by tribes organised into unilateral social groups It is believed that a sufficient number of extrinsic, arbitrary factors are shown to underlie these institutions in their several areas to support the view of the unitary origin of native American unilateral groupings, contrary to the current opinion of American anthropologists, who hold that they represent from two to upwards of six independent growths If the hypothesis of the unity of origin of all the unilateral institutions of native America be accepted, their wide spread distribution points to a very respectable antiquity The clan organisation bulks large in every area from which we have data, except in the southern part of the North Pacific coast Unilateral institutions may be assigned to the 'archaic' period of American culture along with shamanism, crisis ceremonies, and so on, while the derivation of American clans from the Old World as a concomitant of the migrations makes it unnecessary to posit their special creation in the New World The Old World distribution of unilateral institutions falls into line, being practically universal in Siberia, except among some of the Palæo Siberians There is the strongest evidence for them in Old China and for their antiquity over the greater part of the Old World

Maximum Yield of Ceylon Pearl Oysters In the September number of the *Ceylon Journal of Science* (Section C Fisheries Vol 4 1933) there are two very interesting papers connected with pearl oysters, "The Maximum Pearl Yield of a Pearl Oyster Bed" by Joseph Pearson, and "Further Observations on the Age and Growth rate of the Ceylon Pearl Oyster, *Margaritifera vulgaris*, with Special Reference to Oysters of Donnan's Muttuvarattu Paar" by A H. Malpas The first discusses the theoretical aspects of the problem of deciding the optimum for fishing a mixed bed of pearl oysters In the second, some practical aspects of the same problem are indicated and an account is given of the different phases in the life history of a bed of oysters on one important paar Dr Pearson deals with his subject on mathematical principles, basing his work on the two main considerations affecting the problem (1) that the normal rate of mortality of an oyster bed is very high, and (2) that the pearl yield of the oyster increases with age Oysters older than 5 years are very rare, and the best age for fishing is probably between 3½ and 4 years Having due regard for the age limit of the oyster, the longer the fishery is postponed the fewer the oysters but the greater the average pearl yield The question is how to strike the balance and find the time when the bed may be expected to attain its greatest value At present, purely practical methods are used for estimating the numbers and computing the approximate pearl value of a bed, but the author suggests that a valuable research could be followed in the immediate future on the lines laid down in his paper for determining the optimum of a bed of mixed oysters

Plankton in the Java Sea. Dr H C Delsman in his paper "Over het Productievermogen der Tropische Zeeën' (Delsman en Hardenberg De Indische Zeevisschen en Zeevisscherij ter perse bij Visser and Co, Batavia C 1933) deals with quantitative plankton investigations in the Java Sea and phosphate determinations As was to be expected in a shallow tropical sea, he finds much less plankton in these regions than in the North Sea, where he has made similar observations at the *Haaks* Lightship The phytoplankton is restricted to a relatively narrow belt along the coast, the life farther out being predominantly animal In Sunda Strait, which has strong tidal currents, there was much more plankton, especially on and near the border of the continental flat Copepods were more than five times as numerous as in the Java Sea Five large species of copepods are predominant in the plankton—*Euchaeta concinna*, *Undinula (Calanus) vulgaris* forma *minor*, *Eucalanus subcrassus*, *Candacea bradyi* and *Labidocera acuta*, the largest being *Undinula*. There are also many smaller species The diatoms are mostly well known and widely distributed species which occur also in northern seas The copepods are very important as they are the chief fish food. It is interesting to find that the structure of the gill rakers is finer in those plankton-eating fishes which feed on the fine coastal plankton than in those which feed on the larger plankton farther out

Deposition of Fat in the Animal Body The mechanism of the penetration of fat into the cells of adipose tissue during fattening and its issue from the cells during fasting is a physiological problem which, despite much investigation, still remains unsolved In a paper published in the *Memoirs of the Royal Italian Academy*, 4, 1933, Dr Gaetano Quagliariello summarises the present state of knowledge of this question and gives a brief account of his own experiments His results indicate the existence, in the cells of adipose tissue, of a lipase capable of attacking glycerides of the higher fatty acids and of an enzyme which is able to dehydrogenate the higher fatty acids but not their esters It was found, moreover, that lipolysis and also oxidation phenomena which must be, at least partly, dehydrogenating in character, are detectable in adipose tissue detached from the organism In experiments on dogs it was observed that, during fasting the degree of unsaturation of the fatty acids, both of the adipose tissue and of the blood, underwent appreciable increase On these data is based the hypothesis that, prior to its mobilisation, fat is hydrolysed and the resulting fatty acids are rendered sufficiently unsaturated to make them diffusible It is considered probable also that, under normal conditions of nutrition at any rate, penetration of fat into adipose cells is effected by a similar mechanism

Action of Growth Substance in Plants It has long been recognised that the terminal bud of a stem inhibits the development of lateral buds, causing them to remain dormant, but the mechanism of this action has not been understood Messrs Thimann and Skoog (*Proc Roy Soc*, B, 114, 317) put forward an interesting hypothesis based on numerous experiments with young plants of *Vicia Faba* The work of Went and others has shown that the coleoptile of *Avena* produces a growth substance (auxin) The present authors conclude that the same substance, diffusing from the terminal bud, acts as an inhibitor of growth in the buds below By placing the terminal bud on a small block of agar into which the auxin diffused, and then placing the agar block on an *Avena* coleoptile, they were able to get a measure of the amount of growth substance produced by the terminal bud It was also found that the lateral buds produce no auxin while dormant, but begin to produce it when their growth begins The growth substance was also produced by the leaves, especially when young Application of growth substance to a decapitated stem similarly suppresses the development of the lateral buds in accordance with the amount applied It was further shown that the growth substance causes elongation of the stem, both in intact plants and in isolated portions of stem, the stimulus being to cell elongation and not to cell division The amount necessary to produce elongation is much less than that required for bud inhibition The stem was found to show a greater response to auxin in the dark, but the production of this substance takes place only in the light It thus appears that the same substance which promotes cell elongation in the stem inhibits the development of lateral buds

✓**Leaf Stripe of Oats.** A severe disease of oats known as leaf stripe is caused by the fungus *Helminthosporium avenæ*. It can be controlled readily by means of disinfectant dusts applied to the grain, but several new facts about the life history of the fungus are published in a recent paper ("Studies in the Morphology and Biology of *Helminthosporium avenæ*", by R W G Dennis, *Trans Brit Mycol Soc*, 18, part 3, 223–237, Dec 1933) Primary symptoms occur on the seedlings, the coleoptile being infected from spores on the grain each year Then spores are produced, which infect the more mature parts of the plant, giving secondary symptoms The fungus produces sclerotia and spores within pycnidia, and grows best at a temperature of 20° C Secondary infection is largely dependent on a high relative humidity in the crop The paper under review is the result of fifteen years' investigation of the causal fungus

Propagation of Plum Rootstocks The necessity for the vegetative propagation of rootstocks for fruit trees is now generally realised, and has stimulated the investigation of various methods of multiplication Layering and stem cuttings are used in Great Britain, though on the Continent root cuttings are employed to some extent A great deal of information is given in a recent paper by Messrs T N Hoblyn and R C Palmer (*J Pom and Hort Sci*, 12, No 1, March 1934) The variety Pershore Egg proved entirely unsuitable for propagation by root cuttings, whilst the Common Mussel plum rooted with ease October, December, January and February seem to be good months for the preparation and planting of cuttings, which are recommended to be 9 in long, and not less than ½ in in diameter The yield of cuttings from even a 3 year old tree is low, and the method would seem to be applicable commercially only when roots can be trimmed from general nursery stock Great interest is attached to the method of experiment, which departs from the usual plan of controlling the variables, and combines them in a complete variety of ways, thus giving combinations some of which are successful

✓ **Sodium Chlorate as a Weed-Killer** Dr M A H Tincker has prepared a useful digest of our present knowledge of sodium chlorate as a weed killer ("Tests of Sodium Chlorate as a Garden Weed Killer", *J Roy Hort Soc* 59, 107, Feb 1934) The paper begins with an account of experiments conducted at the Society's gardens at Wisley on the destructive action of sodium chlorate on various weeds It is shown that it is quite effective, and it ceases to have any action after about seven months from the time of application There are thus no harmful after-effects as with arsenical weed killers From other literature, it appears that a 10 per cent solution (1 lb per gallon of water) is required for the eradication of large grasses and docks, a 5 per cent solution for herbaceous weeds and small grasses, whilst small annual weeds are destroyed by a 2½ per cent solution The liquid is applied at the rate of 1 gallon per 10 square yards Dry sodium chlorate must be handled with care, but the chances of any grazing animal taking a harmful dose seem very remote Costs of treatment are low, and one may imagine a time when a dressing of sodium chlorate may replace the exorbitant incubus of a bare summer fallow

Temperature of the Atmosphere in Northern India. In *Gerlands Beiträge zur Geophysik*, 39, 121, 1933, there is a paper by Barkat Ali of the Meteorological Office, Poona, entitled 'High Lapse Rates of Temperature and their Diurnal Variation in the Surface Layers of the Atmosphere over Northern India" The observations were made at Agra (lat 27° N) in March 1925 with sounding balloons carrying a temperature recording apparatus of greater sensitivity than those usually used in work with sounding balloons, and protected from solar radiation by a polished aluminium shield They showed a surprisingly rapid decrease in the amplitude of the diurnal variation of temperature with height, the change being from an average of about 25° C near the surface to about 2° C between heights of 300 and 400 metres above the surface The relationship between the amplitude of the diurnal range and the height was such as to suggest that the amplitude would probably be negligible at a height of 1,000 metres at Agra The lapse rate of temperature was generally greater than the dry adiabatic rate (9 9° C per 1 000 metres) near the surface during the middle of the day and at times even exceeded the lapse rate corresponding with a constant air density in the vertical (34 2° C per 1,000 metres) These inversions of temperature generally extended to a height of 300 or 400 metres, and occasionally temperature was 16° C higher at the top of the inversion than 1 2 metres above the ground, though generally the difference was between 4° C and 6° C

Secondary γ-Rays of Nuclear Origin. Gray and Tarrant Chao, and other workers have found a secondary γ radiation when several elements are exposed to the penetrating γ rays from thorium C'' Gray and Tarrant have now examined this radiation in more detail (*Proc Roy Soc*, A, Feb) The absorption curve of the radiation in lead has been very carefully determined, using alternative primary sources of radium C and thorium C All the elements studied give a soft secondary radiation of quantum energy about 0 5 × 10^6 volts when irradiated by thorium C'' With lead (and to a lesser extent with elements of lower atomic number), a harder radiation of energy about 1 1 × 10^6 volts is also emitted When radium C rays were used, a similar phenomenon was observed, but the soft radiation had an energy which the authors think is significantly less than 0 5 × 10^6 volts This is extremely puzzling, since this difference seems to exclude the possibility that the radiation is a characteristic radiation of the secondary emitter and that the primary radiation serves simply to excite it Special experiments with a Wilson chamber and with a hydrogen filled ionisation chamber showed that the radiation was really γ rays and not a neutron emission The emission seems to be isotropic and to correspond with the whole of the 'anomalous' nuclear absorption of γ rays The authors examine the question of the relation of the radiation to the production and annihilation of positive electrons—an explanation on these lines is very attractive for the thorium rays but seems to leave the phenomena with radium rays unexplained

A New Diode for Electronic Oscillations. Reference was made in a letter to NATURE of May 13, 1933, p 691, to the construction of a novel and simple type of two-electrode valve for the generation of very high frequency electronic oscillators The same contributor, Mr J S McPetrie, has now published in the *Wireless Engineer* of March 1934 further details of this diode and some experiments carried out with it at the National Physical Laboratory The valve differs from the conventional type in that the central electrode is the anode, consisting of a tungsten rod 1 mm in diameter, around which as axis four tungsten filaments are arranged on a ring 12 5 mm in diameter When these filaments are heated and the anode potential is raised to about 360 volts, oscillations are obtained either in an aerial connected to the anode or in a Lecher wire system suitably connected between anode and filament These oscillations are presumed to arise from the periodic motion of the electrons past the anode, along diameters of the cylindrical cathode which the four filaments virtually comprise The wave length of the oscillations under the above conditions was about 1 5 metres and was mainly dependent upon the adjustments of the external circuit With an anode potential of 600 volts, the wave length could be varied from 0 94 metre to 1 2 metres by adjusting the length of the circuit The intensity of the oscillations obtained passes through a maximum value as the filament current is varied, but their production was shown to be independent of the application of an external electrostatic or magnetic field to the valve

Action of Papain on Ovalbumin. Svedberg and Eriksson (*J Amer Chem Soc*, 56, 409, 1934) have made a number of determinations by the ultra-centrifuge method of the sedimentation constant and molecular weight of products obtained by digesting pure crystalline ovalbumin with activated and unactivated papain at 40° Attempts were made to separate the products by fractional dialysis and fractional precipitation with ammonium sulphate, the fractions being ultra-centrifuged Unactivated papain produced no influence on the sedimentation constant of ovalbumin and no non centrifugible products were formed Activated papain gave rise to three kinds of disintegration products One was a non centrifugible substance which probably contained lower polypeptides and aminoacids The second was a centrifugible substance of a sedimentation constant of about 0 6 × 10^{-13}, which with regard to molecular weight is of the same order as the protomines The third product had the same molecular weight as ovalbumin, with a sedimentation constant of 2 7 × 10^{-13}, and was probably formed by the loosening of some of the bonds within the ovalbumin molecule, thus causing it to assume a highly dissymmetrical shape This may represent the first step towards the breaking up of the molecule into individual parts The third substance was found to be practically homogeneous with regard to molecular weight Papain has its maximum activity within the stability range near the isoelectric point of the protein

Superheated Water Mr J Small, of the James Watt Engineering Laboratories, University of Glasgow, has sent us an account of an experiment in which a drop of de aerated water was heated in a glass tube of 1/16 in bore open at one end The temperature of the oil bath in which the tube was heated was taken to 304° F before the drop was explosively expelled The degree of superheat was 90° F, whilst previous experimenters, it is stated, attained only 16° F. of superheat

Conservation of Tropical Forests

THREE articles which have appeared in the *Empire Forestry Journal* (vol 12, No 1, 1933) display the difficulties which exist in conserving and putting to their fullest utilisation the tropical forests of the Empire To take the second case first, Sir Ralph Pearson, formerly director of the Forest Products Laboratory at Princes Risborough discusses the problem of creating and developing markets for Empire hardwood timbers at home

Sir Ralph briefly reviews the reasons why well known timbers have not found favour amongst markets in Great Britain, ascribing some of the causes to the fact that the consignments sent over were often not carefully chosen, nor, with the facilities available in the forests, was there much chance of their being so chosen when the short handed and over worked forest officer was himself responsible for their dispatch Sir Ralph deprecates trying to push too many new timbers upon the markets at the same time, and points out the way in which chosen timbers should be forwarded and tested

A second article, by Mr J B Clements, conservator of forests in Nyasaland, treats of the cultivation of finger millet (*Eleusine coracana*) and its relation to shifting cultivation in Nyasaland This article, and the practice dealt with, is typical of one of the chief sources of the disappearance of valuable forests in tropical countries, the difficulties facing the administration, not always convinced of the increasing injury supervening, in weaning the people from so wasteful a form of primitive agriculture, and finally, of the troubles of a forestry department well aware of the evils resulting from the practice

'It is therefore clear that shifting cultivation in Nyasaland is accelerated to a very considerable extent by the growing of *Eleusine coracana* under prevalent methods Compared with the growing of other crops, the requisites of the millet make extravagant demands as regards the use of land, and systematic burning of the top soil combined with flat cultivation when carried out on any large scale leads to widespread loss and impoverishment of the soil, particularly in hilly country Rapid deforestation inevitably takes place in any wooded country where the millet is grown, as conditions are there ideal for providing both new soil for each crop and fuel for heating the soil "

The third article, by N V Brasnett, conservator of forests, Uganda, discusses the formation of State forests, and forest rights and privileges of local inhabitants in Uganda After briefly reviewing the position of the colony from the day, in 1890, when Capt (now Lord) Lugard signed a treaty on behalf of the British East Africa Co with the King of Buganda the declaration of the British protectorate in 1894, and Sir Harry Johnston's arrival in 1899 and subsequent organisation of the administration of the country, the author concentrates upon the various arrangements, regulations and ordinances for the management of the forest areas of the country

It is impossible to deal with the varying policies to which succeeding administrations subjected the forests after the first and promising lines were laid down But a perusal furnishes evidence that one of the past flaws in colonial administration has been the refusal or inability of those responsible for the future welfare of their charges to lay down a definite forest policy, based on wide views, and to adhere to it

Mr Brasnett ends his summary of the present position of the forests in Uganda with the sentence

When formation is completed it is estimated that the State forests of Uganda will constitute just about 2% of the total land area of the Protectorate, and the total forest area, including private woodlands and the valuable savannah, just over 3%, so that it is obviously essential to preserve the whole of this small percentage " Many conversant with the tropical forest and the importance it plays in countries where it exists would consider the percentage dangerously low

Band Spectrum of PN and its Significance

OF the diatomic emitters of band spectra, few have been more extensively studied than the 14 electron molecules N_2 and CO, which are responsible for many observed band systems and, unlike most emitters, are well known as stable molecules rather than as intermediate products in chemical reactions or equilibrium products at high temperatures Emitters which are chemically or spectroscopically analogous to these two have, as would be expected, also received considerable attention, the best known examples being the 30 electron molecule P_2 and the 22-electron molecules SiO and CS

To the latter category the PN molecule becomes an interesting addition as the result of the recent discovery and analysis, by J Curry, L Herzberg and G Herzberg[1], of an ultra violet band system which is produced by an electrical discharge through a mixture of phosphorus vapour and pure nitrogen With a heavy discharge (about 6000 v and ½ amp) in a water cooled tube, this PN system has been photographed in the first and second orders of a 3 m grating, and both the vibrational and rotational structures analysed

The new bands extend from λ2375 to λ2992, are degraded towards the red and have a fine structure characteristic of the electronic transition designated as $^1\Pi \rightarrow {}^1\Sigma$ The system is therefore similar to those of the iso-electronic molecules CS and SiO in the same spectral region and to the well known fourth position system of CO and the Lyman system of N_2 [2] The P_2 ultra violet system is not analogous to these as it is due to a $^1\Sigma \rightarrow {}^1\Sigma$ transition[3], other and less refrangible P_2 bands are known, some of which may, when analysed, prove to belong to the expected $^1\Pi \rightarrow {}^1\Sigma$ system

From the accompanying table of the more important numerical constants for the electronic states concerned, it is clear that the three 22 electron molecules are similar to one another and intermediate to the 14 electron and the 30-electron molecules in respect of the vibrational coefficients ω_e and $x_e\omega_e$, the rotational coefficient B_e and the equilibrium inter-nuclear distance r_e With CO, N_2, SiO and P_2, the band systems under discussion have been observed in absorption as well as in emission, and the lower ($^1\Sigma$) states are therefore stable ground states The same is expected, though not yet observed, to be true of CS and PN, that is to say each of these should be capable of existence as gaseous substances in the absence of an electric discharge, J Curry and L and G Herzberg are further investigating the PN system from this point of view

Molecule	$^1\Pi \rightarrow {}^1\Sigma$ ν_0 (0 0) cm.$^{-1}$	Upper State $^1\Pi$ ω_e cm^{-1}	$x_e\omega_e$ cm^{-1}	B_0 cm^{-1}	r A U	Lower State $^1\Sigma$ ω_e cm^{-1}	$x_e\omega_e$ cm.$^{-1}$	B_e cm^{-1}	r_e A U
(14) CO	64765	1516 7	17 24	1 600	1 232	2167 4	12 70	1 85	(1 15)
(14) N_2	68962 7	1692 28	13 318	(1 52)	(1 26)	2359 60	14 445	1 992	1 094
(22) SiO	42690 0	851 51	6 143	0 6270	1 62	1242 03	6 047	0 7238	1 51
(22) CS	38796 3	1072 2	10 05	0 74	1 61	1282 5	6 00	0 79	1 56
(22) PN	39688 5	1103 09	7 222	0 7274	1 542	1337 24	6 983	0 7834	1 487
(30) P_2						780 43	2 812	0 3133	1 856

The heat of dissociation of the $^1\Sigma$ state of PN is estimated as 7 8 volts from a Birge Sponer linear extrapolation of vibrational energies and as 6 3 volts from a consideration of probable products of dissociation It is thus somewhat less than that of N_2 (recently given as about 7 9 volts[4] rather than the hitherto accepted value of about 9 0 volts[3]) and greater than that of P_2 (5 0 volts[3]) Similarly the heats of dissociation of CS and SiO (each roughly 8 volts) are less than that of CO (about 10 volts)

The molecules discussed here are all composed of nitrogen, phosphorus and their immediate neighbours in the periodic table From the atoms preceding and following these we have other 22 electron molecules about which, however, nothing can yet be stated, namely BCl (bands observed in the same spectral region but not systematised[5]) and AlF (expected band system not yet recorded)

W JEVONS

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[1] *J Chem Phys* 1 749 1933 (preliminary report) *Z Phys* 86 348 1933

[2] Particulars of these band systems and of the notation used in the PN paper and in the present article are given in the writer's Report on Band Spectra of Diatomic Molecules' (*Phys Soc* 1932) The more recent analysis of SiO bands is by Saper (*Phys Rev*, 42 498 1932) and that of CS bands is by Crawford and Shurcliff (*Phys Rev* 42 766 1933)

[3] G Herzberg *Ann Phys* 15 677 1932

[4] Lozier *Phys Rev* 44 575 1933

[5] Lochte-Holtgreven and van der Vleugel *Z Phys* 70 188 1931

Biology of Heavy Water

IN *Science* of February 16 1934 Prof Gilbert N Lewis summarises the results of certain sporadic attempts to observe the effect of water containing heavy hydrogen, H^2, upon living organisms Experiments have necessarily been confined to small organisms, though some preliminary observations on mice are included The first experiments were upon tobacco seeds, the germination of which was completely retarded by pure H^2_2O and slowed up some 50 per cent by water containing 50 per cent H^2_2O Seeds transferred to normal water after three weeks in pure H^2_2O sprouted in about half the cases but gave unhealthy seedlings Yeast cultures in an appropriate nutrient medium dissolved in pure heavy water failed to grow, and Pacsu has also shown that the evolution of carbon dioxide by yeast from sugar solution made up with heavy water is much diminished

In an experiment that was expensive if preparatory in nature, a mouse was supplied in three doses with some 0 66 gm of pure H^2_2O The mouse survived, though during the experiment it showed marked signs of intoxication" The symptoms of distress seemed more marked after each dose but not cumulative, which led Prof Lewis to conclude that the heavy water was being voided, but no preparation had been made to test this point Prof Lewis concludes that H^2 is not toxic in any high degree but that its complete substitution for H^1 leads probably to a complete inhibition of growth, an effect which is to be traced to the greatly reduced rate of all physico chemical processes when H^2 is substituted for H^1 '

Mr S L Meyer of the Vanderbilt University Biology Department describes in *Science* of March 2 culture experiments with a blue mould, in which those grown on media made up with one out of every 214 hydrogen atoms H^2 gave sixteen times the yield of fungus as those grown on control solutions free from H^2

The late Dr Edward W Washburn and Dr Edgar R Smith have been carrying on experiments at the Bureau of Standards at Washington in which they have studied the proportion of H^2 atoms present in the tissues after plants have grown in normal soil solutions So far as could be judged, rooted willow cuttings absorbed H^1 and H^2 in the proportions in which they were present in the original water supply, but apparently the heavy hydrogen was selectively accumulated in the tissues as the expressed sap contained water 2 8 parts per million heavier than normal water whilst the water obtained from the destructive distillation of the willows was 5 4 parts per million heavier than the normal supply Dr Washburn died suddenly on February 6, his report with Dr Smith has been published since, in *Science* of February 23

Universe and Atom

THE issue of *Die Naturwissenschaften* of March 9 contains the address on this subject which Prof Wehl of Göttingen gave at the opening of the holiday course on mathematical sciences given at Göttingen in July 1933 His object was to put before his audience only such conclusions as are at the present time reasonably certain and to avoid any fantastic speculations

By representing space in the space time continuum as the abscissa and time as the ordinate of a point on a curved surface, Prof Wehl shows how the Einstein continuum with its mass distribution is represented by a cylindrical surface with its axis vertical and its radius determined by the density of distribution of mass Stars at rest are represented by generating lines and the movement of light through the universe by spirals the pitch of which is equal to the time the light takes to go round the universe The stars are thus represented at different epochs separated by æons

De Sitter's massless continuum is, on the other hand, represented by a hyperboloid of one sheet with its time axis vertical, and lines of shortest length now represent the stars while the movement of light through the universe is represented by a straight line generator in which a tangent plane to the asymptotic cone cuts the surface As this cannot intersect a geodesic a second time, there is no repetition of the representation, and as the geodesics themselves change their distances apart as they travel over the surface the universe must be either expanding or contracting

Neither the gravitational universe of Einstein nor the non gravitational one of De Sitter corresponds sufficiently closely with the facts, but the later one of Friedman and Lemaître, according to which space is spherically bounded and the boundary expands with time, is much more satisfactory The radius of space is about 10^{27} cm and the total mass it contains is about 10^{27} that of the earth, possibly due to 10^{80} particles

In the atom the electrical forces between its constituents are about 10^{40} times the gravitational, a ratio which may have some connexion with the square root of the number of particles in the universe The wave length associated in wave mechanics with the electron, when multiplied by the constant known as the fine structure constant (1/137), gives the radius of the electron and when divided by it the radius of the atom The product of the wave length of the electron wave by the square root of the number of particles gives the radius of the universe and when divided by it the gravitational radius of the electron

Although in this theory the appearance of the square root of the number of particles in the universe can be understood, there still remains considerable obscurity with regard to the wave length of the electron wave and the fine structure constant

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Science News a Century Ago

John Phillips at King's College

When Lyell in 1833 resigned the chair of geology at King's College, London, he was succeeded by John Phillips (1800–74), the nephew of William Smith Phillips began his courses of lectures on April 21, 1834 The science of geology, he said, was of but recent growth and it was necessary that students should be cautious as to the reception of theories, many of the theories which had been introduced were the results of imagination rather than the deduction of actual observation Nothing was to be received as truth but what was warranted by actual observation and diligent research If the science were pursued with strict attention to these preliminary principles, the benefits which would arise to those who pursued it would be commensurate with their desire of truth In the course of his remarks, he described the primary, secondary and tertiary deposits and explained the position of the various strata of rock He directed attention to the incontrovertible fact that in the various strata fossils had been discovered including many thousands of species of animals and vegetables which were no longer found in the animal and vegetable kingdoms by which the surface of the earth was covered, and deduced from this fact that it was obvious that the system of Nature had in the revolution of ages under gone many changes He reminded the students of the high eminence to which their fellow countrymen had exalted the science and begged them to remember that the philosophers of the Continent had their eyes upon their proceedings and success

Honours for Men of Science

Shortly after the first meeting of the British Association, William IV conferred the Guelphic order of knighthood upon David Brewster, Charles Bell, John Leslie, John Herschel and other men of science In the spring of 1834, the subject of honorary distinctions for eminent scientific persons was discussed in the House of Commons, the discussion leading Vindex' on April 22, 1834, to address a letter to the editor of the *Times* mentioning one or two points which he considered had been over looked In the first place, he said, the Guelphic order of Hanover, the only one conferred so far, was one of the lowest on the Continent The title of knight could not be assumed until the recipient had been to court, and as this could not be done under an expense of nearly £200, several persons whom it had been intended should be honoured had been unable to stand this expenditure Secondly, the order was a foreign' one and after the death of King William it could not again be granted and the knighthoods already conferred would lapse It surely," said Vindex, would be more becoming in the Sovereign and more worthy of the nation either to make a new order or enlarge one of the present ones so as to embrace such persons as are distinguished in art or science "

Progress in Lighthouse Illumination

In the *Mechanics Magazine* of April 26, 1834, a correspondent described a visit he had made to the National Gallery in Adelaide Street, London, where an exhibition was being held illustrating the various methods of illumination in use for lighthouses and for geodetical operations So late as 1811, the writer said, the Eddystone lighthouse was illuminated by wax candles, while in 1812 a coal fire was still in use at the Lizard By 1834 the general method adopted in British lighthouses included the use of oil burning Argand lamps in conjunction with parabolic mirrors of silvered-copper This type of illumination was stated to be due to Mr Ezekial Walker of Lynn, who had fitted up the Hunston light on the Norfolk coast in 1778 Many kinds of vegetable and animal oils had been tried with Argand lamps but spermaceti had been found to be the most suitable Coal gas had been tried in some foreign lighthouses, that at Dantzig having been lit by gas in 1819

After referring to the introduction by Arago and Fresnel of the plano convex lens in French lighthouses and to the Cordovan lighthouse at the mouth of the Garonne, then the finest in the world, the writer said that, as lenses of more than 15 inches diameter were not easily made, the lens system would not have found the favour it had but for "the discovery of our distinguished countryman Sir David Brewster that by surrounding any lens with a series of glass rings of a particular curve, it might have its effect magnified to any given extent" Other methods of illumination shown included a primitive form of arc light and the hydro oxygen limelight of Lieut Drummond, which gave a light ' only inferior to the sun itself"

Botanic Garden, Oxford

'It is much to be regretted that the city of Oxford has not a botanic garden suited to the rank which it holds as a British university Were a small sum contributed by each of the colleges yearly, even the present garden might be rendered doubly efficient more especially if the adjoining ground at present occupied by Mr Penson, were added to it, and a part, or the whole of the meadows of Christ Church But the situation is altogether bad, and, for a botanic garden worthy of Oxford, a dry, open, ample, airy piece of ground should be selected outside of the town, say, somewhere about Jeffery s Nursery The present botanic garden might still be continued as such, on a smaller scale, so as to suit the income destined for its support Till lately there has been a great want of botanical taste among the Oxford professors, but hope that a taste for botany, as well as a taste for geology, is now dawning upon them, and, whenever it does, they will soon produce a botanic garden worthy of themselves After a botanic garden is established, a zoological garden will follow, and, perhaps, ultimately, a public ornamental garden surrounding the whole city as a breathing zone' (J C Loudon, *Gardener's Magazine*, April 1834)

Societies and Academies

London

Physical Society, March 2 A O Rankine A simple method of demonstrating the paramagnetism and diamagnetism of substances in magnetic fields of low intensity (see Nature, 133, 150, Jan 27, 1934) A M Ferasah Anomalous changes in temperature due to thermionic emission in the filaments of valves In some valves the steady filament temperature is lower when the anode is positive, as would be expected but in other valves it is higher This anomalous increase in temperature is due to radiation from the anode and is larger for valves which have a high anode dissipation and an anode which closely surrounds the filament After correction for this effect has been applied, the work function can be approximately calculated from measurements made on an ordinary valve T Smith Change of variables in Laplace's and other second order differential equations Transformations of variables are expressed as matrix products, the effect of transposition being particularly considered, and the results are applied to the transformation of the general second order differential expression Mary Taylor The Appleton Hartree formula and dispersion curves for the propagation of electromagnetic waves through an ionised medium in the presence of an external magnetic field (2) Curves with collisional friction Four typical frequencies have been chosen for the calculations, one from each of the classes into which the frequencies fall when collisional friction is absent, as described in part 1 The corresponding wave lengths are 80, 240, 400 and 1,000 metres The various stages in the effect of increasing collisional friction have been found to be usefully represented by collisional frequencies of 10^5, 10^6, 10^7 c/sec and curves are given showing the indices of refraction κ_r $(r=a, b)$, and the real part and imaginary part of M_r^2 or $(\mu_r - i\kappa_r\, c/p)^2$, together with the polarisations of the basic modes as functions of the electronic density for each of the four frequencies and collision frequencies named The process of evaluation of M_r and of the polarisation is described The attenuation and absorption are found to be, in general, greater for the right handed component than for the left-handed component, with the direction of magnetic field appropriate for down-coming waves in the northern hemisphere The use of the dispersion curves in the interpretation of propagation phenomena is discussed J McGarva Bruckshaw An instrument for electrical prospecting by the inductive method In the Bieler Watson method of geophysical surveying, in general, the horizontal field is not in quadrature with the vertical field An instrument has been designed which will allow the horizontal field to be compared completely with the vertical field, an important feature being that the horizontal components in phase and in quadrature with the vertical field are obtained directly from the instrument readings The apparatus has been tested on elliptically polarised fields and has given satisfactory results

Paris

Academy of Sciences, February 26 (*C R*, 198, 777–860) C Matignon and A de Passillé The ammonium arsenates An account of the preparation of anhydrous triammonium arsenate, of the dissociation of this and the diammonium arsenate The properties of a new ammonium metarsenate are also described Marin Molliard and Robert Echevin The ovarian fluid of rust (*Agrostemma Githago*) and its relations with the seminal tegument R de Montessus de Ballore The determination of the median in the binomial function Paul Lévy The generalisation of the differential space of N Wiener René Lagrange A class of congruences of circles S K Zaremba The course of the integral curves of the equation $Y(x\ y)dx - X(x,y)dy = 0$ in the neighbourhood of an isolated singular point A Kovanko The structure of almost periodic generalised functions Jean Grégoire Certain shock phenomena produced in differentials R Swyngedauw The friction couple of ball bearings Loève The integration of Dirac's equations Y Rocard The quantic absorption of sound in gases Arcadius Piekara and Bruno Piekara The thermal hysteresis of the specific inductive capacity and of the conductivity of aqueous solutions of gelatine J Thibaud and F Dupré la Tour The diffusion and absorption of positive electrons traversing matter Experiments based on photographic methods, using the Chalenge Lambert recording microphotometer, lead to the conclusion that positive electrons behave like negative electrons, they undergo multiple diffusions near the charged atomic centres with progressive deceleration G A Boutry and J Orcel Remarks on the comparison of the properties of vacuum (photoelectric) cells with those containing a gaseous atmosphere Criticism of work on the same subject by L Capdecomme Alb Perrier and Mlle T Kousmine The longitudinal magneto thermoelectric effects in nickel and iron The experimental laws From experiments with an iron nickel couple it is concluded that, with the magnetisation parallel to the temperature gradient, the thermoelectric power is increased normal magnetisation, on the contrary, lowers it O Miller and J Lecomte The infra red absorption spectra of the stereoisomeric orthodimethyl-cyclohexanes Since the molecular structure of these two stereoisomers is not the same, different infra red absorption spectra would be expected, and this is shown by experiment to be the case The Raman spectra of the same compounds are also given A KASTLER The amount of polarisation of the fluorescence of mercury vapour in the presence of nitrogen JEAN GENARD The magnetic extinction of the fluorescence of the diatomic molecules of tellurium Repetition of the work of Smoluchowski, utilising the large Bellevue electromagnet, which gives stronger fields MME BRANCA EDMÉE MARQUES The distribution of the radium in crystals of radiferous barium bromide EDMOND BANDERET The formation of Liesegang rings by electrolysis Utilising the method of producing very clear rings described in an earlier note Veil s relation $\sqrt{\delta}=an+b$, where n is the order of ring and δ the distances between the rings was verified, a was also found to be inversely proportional to the voltage applied MLLE LUCIA DE BROUCKERE The adsorption of electrolytes by crystalline surfaces The influence of the sign of the electric charge of the adsorbant A MICHEL LÉVY and H MURAOUR The possibility of utilising the microscope in the study of the phenomena of detonation Results obtained by detonation of lead azide, in quantities of the order of 0 5 mgm, and subsequent examination of the lead deposits under the microscope P JOB The constitution of hydrobromic solutions of salts of copper and cobalt A TRAVERS and PIERRE LEDUC A reaction differentiating various hydrated calcium aluminates P BASTIEN The existence of three allotropic varieties of calcium Differential thermal analysis, differential thermoelectric power, expansion and hardness all indicate allotropic changes at 260° C and about 430° C, thus proving the existence of three allotropic varieties of calcium M CHÂTELET and MME P M CHÂTELET Some reactions of divalent chromium acetate Descriptions of the preparation of dry chromous acetate and its reactions with dry hydrogen chloride, pyridine and ammonia MAURICE LOURY An acid alcohol containing the acetylene linkage phenyl phenyl ethinylglycollic acid, $C_{16}H_{12}O_3$ MARCEL GODCHOT and MAX MOUSSERON The resolution of 1 2 trans-cycloheptanediol into its optical antipodes MME E JÉRÉMINE Some rocks from Kenya Colony J CHAZE The mode of formation of the aleurone grains in the Gramineæ and the production in the latter of oxyflavonic and anthocyanic compounds RENÉ VANDENDRIES The haploid and diploid conidian cycle in the Basidiomycetes R KÜHNER The utilisation of cresyl blue in systematic mycology G GUITTONNEAU and A LEROY Opotherapic feeding in milch cows The system of feeding suggested by G Monnot has been tested on a herd of 35 cows with negative results MLLE A DUSSEAU A new durelloid hybrid strain resulting from the crossing of two *Triticum vulgare* PIERRE GAVAUDAN The diffuse vital staining of flagella and the chemical affinities of the cytoplasm and of its various constituents A GIROUD, C P LEBLOND and M GIROUX Vitamin C in the ovary and the yellow body Results of histological studies based on the reaction of ascorbic acid with silver nitrate P PORTIER and MLLE A RAFFY The mechanism of the death of birds the plumage of which is impregnated with hydrocarbons In the normal state the plumage of birds acts as a screen against losses of heat even in a prolonged dive under water near 0° C These heat insulating properties are lost when the feathers are covered with oil and this is the cause of death MLLE G COUSIN: The normal fecundity and characters of the hybrids resulting from crossing two species of grasshoppers, *Achæta campestris* and *A bimaculata* G DELAMARE Numerical variations of some primary sinusoids of the body of the Spirochetidæ

MELBOURNE

Royal Society of Victoria, December 14 W J HARRIS The eastern boundary of the Bendigo gold field A number of traverses across the eastern portion of the Bendigo goldfield show that the Lower Ordovician rocks (mostly Lancefieldian) near the east of the Bendigo city area, end abruptly and are succeeded farther to the east by beds which are uniformly much younger (Darriwilian) The break in the normal succession has been traced for a distance of about fourteen miles and is attributed to a fault named the Whitelaw fault, which runs almost parallel to the strike of the bed rock N 15° W The presence of the Darriwilian non auriferous beds accounts for the absence of profitable gold mining east of the line indicated F A SINGLETON and NELLY HOOPER WOODS On the occurrence of the pelecypod genus *Miltha* in the Australian Tertiary The Tertiary pelecypod, *Dosinia grandis*, Hooper Woods, from a boring near Adelaide, South Australia, is redescribed, refigured and transferred to *Miltha* (*Milthoidea*) in the family Lucinidæ A new subspecies, *flindersensis*, is described and figured from a boring on Flinders Island, Tasmania B J GRIEVE The isolation of the organism causing crown gall on almond trees in Victoria The galls have been shown to be related to the presence of bacteria The causal organism has been isolated in pure culture and has been shown to be identical with *Bacterium tumefaciens* Sm and T R B WITHERS and R A KEBLE The Palæozoic star fishes of Victoria This contribution comprises the Palæozoic star fishes of Victoria and nearly all those of Australia, they are wholly of Silurian age Ten new species have been described Several of the genera represented are new to Victoria, one of the most interesting is *Hudsonaster*, which is regarded as a somewhat primitive type and is only recorded from Ordovician beds elsewhere

VIENNA

Academy of Sciences, December 7 HERBERT HABERLANDT, BERTA KARLIK and KARL PRZIBRAM Synthesis of the blue fluorescence of fluorite Examination of a number of mixtures of fluorite with small proportions of other substances shows that the fluorescence exhibits blue bands only when a rare earth metal, most probably europium, is present After being heated and exposed to radium radiation calcium fluoride, either pure or containing 0 1 per cent of cerium, praseodymium, neodymium or samarium, gives no blue bands, which, however, appear when either impure samarium (containing europium) or pure europium is added (see also NATURE, 133, 99, Jan 20, 1934) ALEXANDER KÖHLER and HERBERT HABERLANDT Luminescence of apatite and other phosphates As with fluorite, so also with many apatites, either in the natural state or after heating, the occurrence of lines in the fluorescence spectrum affords a sensitive means of detecting rare earths Certain other phosphates may be examined similarly GEORG STETTER (1) Process of charging in the ionisation chamber (2) Choice of the grid resistance for a highly sensitive amplifier GUSTAV ORTNER and GEORG STETTER (1) Choice of the coupling element in making an amplifier with low time constant (2) Experiments on atom-disintegration with radium B+C as source of radiation (1) By the procedure described processes of nuclei transformation occurring when RaB+C is used as source of radiation may in spite of the presence of β and γ rays be recorded electrically with the same reliability as when polonium is used **Georg Koller** and **Adolf Klein** Saxatilic acid On the basis of the known chemical behaviour together with new data a structural formula for this acid is proposed **Kasimir Graff** (1) Colorimetric and photometric observations on δ Cephei and η Aquilæ The spectral changes of these two stars show also in the visual colour and are readily detectable with a colorimeter The colour curve of δ Cephei is very similar to but not quite synchronous with the light curve With η Aquilæ however larger deviations occur (2) Regularities in the change in colour of stars on the horizon The excess colour of stars on the horizon observed in Majorca is related linearly to the path of the rays in the homogeneous atmosphere **Rudolf Grill** Oligocene and miocene in the Gallneukirchen basin east of Linz on the Danube and the neighbouring regions **Wolfgang Holzer** Action of rapid electrical vibrations on electrolyte solutions in relation to biological effects of short waves

December 14 **Stefan Pelz** Crystal photo effect in coloured rock salt **A Skrabal** Unstable intermediate products and classical chemical mechanics In investigations on chemical kinetics it is often necessary to decide from a given scheme of reactions in which unstable reactants take part the actual gross reactions occurring and their velocity equations A method of solving this problem based on classical chemical mechanics is now given **K W F Kohlrausch** and **A Pongratz** Studies on the Raman effect (31) Raman spectrum of organic substances (polysubstituted benzenes) Each of the four spectra for the molecular types C_6H_5X and CH_3 C_6H_4X (X in the ortho meta or para position) is analysed for the cases where X is NH_2 OH F CH_3 CN Cl Br or I

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday April 23

Victoria Institute at 4 30—Sir Charles Marston Bible and Spade

Royal Geographical Society at 5 30— Life in Hungary (film)

Tuesday April 24

Royal Society of Arts at 4 30—C F Strickland 'The Co operative Movement among African Races

Thursday April 26

Royal Society at 4 30—F W P Götz, A R Meetham and Dr G M B Dobson The Vertical Distribution of Ozone in the Atmosphere

Dr F P Bowden and Dr C P Snow Physico Chemical Studies of Complex Organic Molecules (1)

Dr F P Bowden and S D D Morris Physico Chemical Studies of Complex Organic Molecules (2)

London Mathematical Society at 5—(at Burlington House, W 1)—Discussion on Integral Functions Speakers Prof E C Titchmarsh, Dr E F Collingwood, Dr M L Cartwright Prof J M Whittaker A J Macintyre Prof J E Littlewood.

Worshipful Company of Armourers and Brasiers at 5 30—(in the Metallurgy Lecture Theatre Royal School of Mines Prince Consort Road, South Kensington)—Prof J H Andrew Alloy Steels (succeeding lectures on May 3 and 10) *

Institution of Electrical Engineers at 6—Prof J C M Lennan Electrical Phenomena at Extremely Low Temperatures (Twenty fifth Kelvin Lecture)

Friday April 27

Royal Institution at 9—J M Stagg 'The British Polar Year Expedition to Fort Rae N W Canada, 1932 33

Official Publications Received

GREAT BRITAIN AND IRELAND

City and County of Bristol Bristol Museum and Art Gallery Report of the Museum and Art Gallery Committee for the Year ending 31 December 1933 Pp 26+4 plates (Bristol.)

Report of the Rugby School Natural History Society for the Year 1933 (Sixty seventh Issue) Pp 44 (Rugby George Over (Rugby) Ltd)

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1933 The Yorkshire Museum, York—Report of the Museum Committee for the Year 1933 Pp 47 (York)

The London School of Economics and Political Science (University of London) Register 1895–1932 Edited by the Registrar of the School. Pp xix+266 (London) 3s 6d net

Thirty third Report of the Felsted School Scientific Society 1932 1933 Pp 54+4 plates (Felsted)

University Grants Committee Returns from Universities and University Colleges in receipt of Treasury Grant Academic Year 1932 33 Pp 26 (London H M Stationery Office) 1s 3d net.

Transactions of the Royal Society of Edinburgh Vol 57 Part 3, No 34 Geology of the Outer Hebrides Part 5 North Harris and Lewis By Prof T J Jehu and Dr R M Craig Pp 839–874+5 plates (Edinburgh Robert Grant and Son London Williams and Norgate Ltd) 6s 6d

OTHER COUNTRIES

The Indian Lac Research Institute Annual Report for the Year 1932 33 Pp 39+6 plates (Nankum)

Columbia University Bulletin of Information Thirty fourth Series No 24 Announcement of Professional Courses in Optometry for the Winter and Spring Sessions 1934 1935 Pp 31 (New York Columbia University Press)

Summary Proceedings of the Twenty-seventh Meeting of the Indian Central Cotton Committee, Bombay held on the 29th and 30th August 1933 Pp 40 The Indian Central Cotton Committee its Objects Activities and Achievements with Special Reference to the Punjab Sind the United Provinces and Central India Pp 32 Annual Report of the Indian Central Cotton Committee Bombay, for the Year ending 31st August 1933 Pp ii+155 2 rupees (Bombay)

Proceedings of the American Academy of Arts and Sciences Vol 69 No 5 Studies on Histomoniasis or Blackhead Infection in the Chicken and the Turkey By Ernest Edward Tyzzer Pp 189–264+6 plates 1 25 dollars Vol 69 No 6 Critical Examination of Physical Anthropometry on the Living By C B Davenport, Morris Steggerda and William Drager Pp 265–284 45 cents (Boston Mass)

Sulphur an Essential to Industry and Agriculture a Treatise on the Properties and Applications of Sulphur Pp vi+45 (New York Texas Gulf Sulphur Co) Free

Southern Rhodesia Geological Survey Short Report No 29 Geological Observations in the Nata Native Reserve Bulalima Mangwe District By J C Ferguson Pp 8 (Salisbury)

Records of the Survey of India Vol 24 Riverain Surveys in the Punjab 1901 to 1929 Pp v+33+2 plates (Dehra Dun) 1 8 rupees 2s 6d

Journal of the Faculty of Science Hokkaido Imperial University Series 2 Physics, Vol 1 No 5 Physical Investigations on Snow Part 1 Snow Crystals observed in 1933 at Sapporo and some Relations with Meteorological Conditions By Ukitiro Nakaya and Tuneo Iizima Pp 149–162+4 plates (Sapporo Hokkaido Imperial University)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia Verhandelingen No 26 Further Researches into the Possibility of Long range Forecasting in Netherlands India By Dr H P Berlage, Jr Pp 31+6 plates Verhandelingen No 27 Daily Forecast of Windforce on Java By Prof Dr J Boerema Pp 8+1 plate (Batavia)

CATALOGUES

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The Glamat Lamp Protector Pp 8 (London The Glamat Co)

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Water Supplies and Emergency Legislation

THE time honoured adage that It's an ill wind that blows nobody any good may possibly receive a further exemplification of its truth and appositeness if the moral to be drawn from the lesson of the recent drought in Great Britain is brought home to the national conscience Even if it were not a matter of common knowledge and it may be added of harsh experience in many parts of the country the serious admissions and warnings of the Minister of Health during the debate in the House of Commons on April 12 on the Water Supplies (Exceptional Shortage Orders) Bill would be more than sufficient evidence of the unpreparedness of the authorities to cope with a general shortage of water such as is now prevalent and although an endeavour is being made in a nationally characteristic way to muddle through' the emergency the situation is one which cannot be regarded with indifference and unconcern In moving the second reading of the measure Sir E Hilton Young made a scriptural reference to the writing on the wall He could scarcely have chosen an illustration of graver import or more sinister significance

Water is one of the most vital requirements of a community whether for domestic or for industrial purposes In Great Britain happily supplies are as a rule reasonably plentiful in fact their abundance under normal conditions has rendered us oblivious of their value and careless in their use With apparently unlimited resources at disposal consumption has tended to become prodigal and in many cases to be swollen by waste For generations past water supply has been a matter of purely individual or local concern Undertakings have been promoted and administered by private companies and by municipalities without reference to the larger needs and requirements of the country as a whole The number of water undertakings in Great Britain is well over one thousand each of them a separate entity and independent of adjacent concerns, however contiguous the boundaries of their respective jurisdictions In addition there are, at least another thousand private proprietors

Amid all this medley of interests and authorities, apart from the formation within recent years of a few regional committees the functions of which are purely advisory and directed towards the attainment of a common policy among local undertakers there has been no attempt at co-ordination or organised control—nothing beyond the casual supervision of Parliamentary committees at times of legislative enactment for new undertakings and the occasional inquiries of the Ministry of Health or the old Local Government Board when sanction has been sought by local authorities for raising loans for expenditure on works

It cannot be claimed that the country has been taken unawares in the matter, or that the evils of this haphazard procedure have not been pointed out During the last half-century, Royal Commissions and Departmental Committees, as well as scientific bodies, have reported time after time on the need for systematic investigation and administration of the national water resources One outstanding instance is the (1921) Final Report of the Water Power Resources Committee, which contains the following pregnant passage

> "We find that the difficulty in fairly allocating the natural sources of water is becoming greater year by year in England and Wales, and the evidence we have heard proves beyond doubt the urgent necessity in the national interests of some measure of control of all water, both underground and surface, in order that the available supplies may be impartially reviewed and allocated, and may be made to suffice for all purposes in the future In consequence of the increase of population, the improvement in the conditions of life and the growing requirements of industry, the demand for water is steadily increasing, and the problem of meeting future needs is giving rise to anxiety in many parts of England and Wales "

The recommendation is clear and unmistakable Other instances might be cited with equal force It will be within the recollection of readers of NATURE that only last autumn a special research committee of the British Association reported to the meeting at Leicester, after a careful and painstaking investigation extending over a period of twelve months, "that the position of inland water survey in the British Isles is far from satisfactory and that a systematic survey of the water resources of Great Britain is urgently required" The Committee pointed out that the consumption per head of population for domestic purposes has a steady tendency to increase, due to improved standards of sanitation, such as the laying on of piped water supplies into houses in rural areas, the substitution of water-closets for privies, and the provision of baths and hot-water supplies Furthermore, while the amount of water required is increasing and large volumes are being allowed to run to waste, supplies are becoming more and more restricted, the most conveniently situated sources having been to a large extent already appropriated Accentuating the growing paucity of available supplies is the fact, mentioned by Sir Hilton Young, that improvements in drainage have resulted in the more speedy draining away of surplus water and so rendered the effects of a drought more serious It is not perhaps generally realised that the rapid spread of building operations during recent years, more particularly in urban districts, together with road-making, has brought about a considerable extension of the area of impervious surface, causing an appreciable augmentation of the run off after rainfall

The Bill just passed by the House of Commons is merely an emergency measure with the inseparable evils of inconvenience and expense It has been forced on the Government by circumstances and, as such, is simply a temporary palliative and not a permanent cure for a state of affairs which, having risen in the past, is equally likely to recur in the future, if matters are left as they are What is needed, and has been needed all along, is carefully considered legislation on the lines of the Water Power Resources Committee's Report, namely, the establishment of a controlling Water Commission the primary duty of which would be to compile proper records of the water resources and to make provision for the present and future water requirements of the country and, thereafter, to supervise the administration of these resources to the general benefit

At the present time, records of available supplies are sadly incomplete, and an efficient survey is the only means of rectifying the deficiency It is true that excellent records of the incidence and extent of rainfall have been, and are being, kept by the British Rainfall Organization, but this is only part of the scheme of a survey, which, in order to be effective, must cover the whole field of observation from the first arrival of water in the form of rain or dew to its final disappearance into the ocean At present, as is pointed out in the British Association Report, there is no official department dealing with the direct hydrological measurements of the amount of water derived from rainfall, which is the really essential feature of the matter from a utilitarian point of view

Hand-to-mouth methods are out of place in the economy of a properly administered community, and the conditions revealed in connexion with the present emergency should compel the attention of the Government and bring home to it the necessity of taking steps without further delay to inaugurate an adequate service for the scientific measurement and impartial control of the water resources of the country. By so doing, it will bring British water administration into line with the practice in other leading countries, where an example in the matter has been set which can be followed with advantage to everybody concerned.

Faraday's Diary

Faraday's Diary: being the various Philosophical Notes of Experimental Investigation made by Michael Faraday, D.C.L., F.R.S., during the Years 1820–1862 and bequeathed by him to the Royal Institution of Great Britain. Now, by order of the Managers, printed and published for the first time, under the editorial supervision of Thomas Martin. Vol. 3: *May 26, 1836–Nov. 9, 1839.* Pp. xii+466. Vol. 4: *Nov. 12, 1839–June 26, 1847.* Pp. xii+448. (London: G. Bell and Sons, Ltd., 1933.) 7 vols., £12 12*s.* 0*d.* net.

THE printing of Faraday's diary pursues its stately and regular course, and two further volumes are before us covering a productive period of eleven years—from the summer of 1836 to the summer of 1847. Once again we are privileged to toil after the amazingly versatile processes of Faraday's mind. It is the story of much less than a decade which is compressed into some nine hundred printed pages if we bear in mind that the diary is a significant blank between September 1840 and June 1842, and between February 1843 and February 1844. Moreover, when we remember the comparative paucity of the resources at Faraday's disposal and his propensity—indeed a necessity of his nature—to do everything for himself, so that it was impossible for him to depute work of even minor responsibility to a student or assistant, we feel that we have surveyed a record of single-handed achievement of which any great school of research might be legitimately proud. Think of it, Cavendish had, years before, measured specific inductive capacities entirely for his own satisfaction and, *more suo*, had left his results unpublished and unknown to his and to Faraday's generation. It was Faraday's part in this period to rediscover this property and to make those measurements which are quoted and misquoted in most elementary textbooks. Here, too, we find the story of the liquefaction and solidification of various gases by compression and cooling in closed tubes. It is interesting to note—and the remark may bring some small consolation to the amateur glassworker—Faraday's comment on his own glass-bending that "the two bends were not very good; one was a little puckered"; interesting, too, to see that Faraday is consistently faithful to the spelling 'guage'.

At a later date, we have the record of the discovery of diamagnetism, and the immortal entry which runs: "A piece of heavy glass, which was 2 inches by 1·8 inches, and 0·5 of an inch thick, being a silico borate of lead, and polished on the two shortest edges, was experimented with. It gave no effects when the *same magnetic poles* or the *contrary* poles were on opposite sides (as respects the course of the polarized ray) nor when the same poles were on the same side, either with the constant or intermitting current—BUT, when contrary magnetic poles were on the same side, there *was an effect produced on the polarized ray*, and thus magnetic force and light were proved to have relation to each other. This fact will most likely prove exceedingly fertile and of great value in the investigation of both conditions of natural force."

Over and above these prime discoveries and their consequences, we have records of experiments on discharge in air and in gases, on regelation, on electrification by steam and air jets. The effect of lightning on a tree in Greenwich Park is set down, as is an account of the aurora borealis seen at Brighton. The Gymnotus at the Adelaide Gallery is put under observation, and the unhappy animal ("probably very languid, though he gives good shocks when one's hands are well disposed") in the presence of Mr. Bradley, Mr. Watkins and Mr. —— deflected galvanometers, decomposed iodide of potassium and (at a later séance) gave "a spark across a striking distance" and did "burn or deflagrate gold leaves in a very striking and effectual manner".

As in the earlier volumes, so here personal, social and political topics pass unnoticed. A queen comes to the throne; Inigo Jones sets Buckingham Palace in an uproar; the first Education Act is passed; and the voices of the protagonists of the Anti-Corn-Law League are loud in the land. No trace of these alarums penetrates the peaceful atmosphere of the Royal Institution, and the nearest approach to personal gossip is chronicled in the last entry in volume four: "AT OXFORD. Sir William Hamilton and self talked over the relations of two electric currents at right angles to each other when, according to Ampère, they have no mutual action I have expected some effect between them analogous to that state of magnetism which must be the equivalent of static electric induction, but could never discover any Sir William Hamilton, I find, expects an effect on mathematical principles Must try again in various ways"

The scientific world is heavily indebted to the managers of the Royal Institution and to Mr Martin, and it were an ungracious task to seek to increase that debt In publishing the "Diary" they are indeed raising to the memory of Faraday a monument more enduring than brass But how much more noble would be the monument were it completed by a similar worthy edition of Faraday's works and his letters, and crowned by that critical biography, of which science and letters still stand in need ! ALLAN FERGUSON

Industry and Leadership

Management of Tomorrow By L Urwick Pp xvii+205 (London Nisbet and Co, Ltd, 1933) 8s 6d net

THERE are few graver problems that confront industry and society alike than that of securing competent leadership under the difficult conditions of our time Important attempts have been made at training for management as exemplified in the Department of Business Administration at the London School of Economics, or the Institute of Industrial Administration, as well as in the courses in industrial administration arranged by the College of Technology, Manchester, but hitherto industry as a whole has made little use of such experiments, nor can it be said that it has given the matter the systematic study and attention which it deserves

On the reasons for this position Major Urwick's thoughtful and stimulating book throws a flood of light Despite the voluminous literature in this field of the last thirty or so years, he makes a definite contribution to management literature which commands attention by the vivacity of its style as well as by the clarity of its thought Discussing first the scientific approach to business management, Major Urwick suggests that what is required is the application of the scientific method of thought to economic activity, as it has already been applied to a large extent on the production side He has a wide and well-balanced conception of management as a science in which an analysis and a basis of fact is substituted for opinion to the limits of our power and knowledge The book abounds in shrewd observations which deserve to be pondered by all who hold or aspire to, administrative responsibility

The mere review of the field of management which Major Urwick supplies in brief compass is in itself challenging, and reveals how much might be done to remove causes of industrial friction and inefficiency This is notably true of research into management problems where Major Urwick does much more than emphasise the opportunities for co operation between different industrial units and industries or the value of what are known as management ratios He directs attention to the growing influence of professional ideals in industry and their power to stimulate such research, as well as to the way in which the elucidation of the principles which should govern the administration of large scale combinations would assist in their efficient administration even without organising genius

On such matters as organisation and distribution, Major Urwick writes in a way that should arrest the attention of scientific workers, noting, for example, how industry has yet to utilise the store of experience of organisation acquired by military institutions or the Church, as well as presenting a highly suggestive programme of market research worthy of the attention of all concerned with distribution In dealing with this difficult field, he conveys a clear conception of what rationalisation really is, as well as exposes some of the muddle headed thinking which has foundered a good deal of industrial enterprise, large and small

If, in this section of his book, Major Urwick gives us a hopeful picture of the possibilities which may attend the application of scientific thought to the problems of distribution, the section on training for management will probably be that most appreciated by scientific workers Whether discussing the training of foremen and supervisors or of administrators, Major Urwick has a keen eye for essentials He reveals the defects of our present lack of system, our failure to grasp that, in education of foremen, leadership and co-operation are the only two ends which matter, and adds one more powerful plea for industry to consider just what it demands of its leaders and recruits and to co-operate with educational authorities to secure an adequate supply of the requisite quality

No part of the book is indeed more thought-provoking than this Major Urwick emphasises industry's responsibility for collaboration in completing the training of its recruits, he directs attention to the dangers of departmentalism and suggests that the naval and military practice of requiring those aspiring to high command to devote one or two years to advanced theoretical work at a staff college at an intermediate stage of their career might be studied in industry Courses of instruction in industrial administration may well find their natural place in industry at some such stage as this Major Urwick's most readable book abounds in constructive suggestions for the utilisation and development of that capacity for leadership in the best sense which is too rare and valuable to be neglected wherever found R BRIGHTMAN

A Digest of Clinical Medical History

A Short History of some Common Diseases By divers Authors Edited by W R Bett (Oxford Medical Publications) Pp vii+211 (London Oxford University Press 1934) 10*s* 6*d* net

SOMEONE has said that to know the history of a subject is already to know more than the half of that subject, or words to that effect Mr W R Bett, formerly honorary secretary of the Section of the History of Medicine, Royal Society of Medicine, has saved all future inquirers into the development of knowledge regarding common diseases a great deal of labour by editing the volume just published Each chapter is written by a different author, someone specially qualified to write on the subject assigned to him, as the following list of contents will show —Acute infectious diseases by Sir John Broadbent, Bt tuberculosis by Prof John Fraser, venereal diseases by Sir D'Arcy Power, pneumonia by E M Brockbank, rheumatism by F J Poynton, rickets by Leonard Findlay, endocrine disorders by Sir H Rolleston, Bt, Bright's disease by Prof J A Nixon, heart disease by Robert O Moon, epilepsy by James Collier, arthritis by John D Comrie, gall stones by Prof D P D Wilkie, tonsils and adenoids by Lionel Colledge, malignant disease by Harold Burrows, and malingering by Sir John Collie

Mr Bett assigned to himself the subject of appendicitis, though, in truth, he might have taken any of the other topics under his wing, of whose quills for literary purposes he has an inexhaustible supply.

It is an immense convenience to be able to have condensed within the compass of a few pages, in each case respectively, a complete synopsis of the references to a disease or a function from the earliest mention to the present day

The essays on rickets, epilepsy, gall stones and malignant disease may be singled out for special praise Much of the ground traversed in these articles is far from the beaten tracks of medical history, and they must assuredly have given their authors no little trouble to compose

Sir Humphry Rolleston's chapter is characterised by a meticulous regard for the earliest occasion on which a particular term was used, and it is conspicuously well provided with dates and with the Greek roots of physiological and medical terms Amongst many other things, we learn from this valuable summary of knowledge that Pierre Marie, who first described acromegaly, is now eighty one years old and that the status lymphaticus is no longer considered to be a pathological entity

Some of the chapters bring home to us vividly the unsatisfactory nature of our knowledge concerning the real source or cause of certain common clinical conditions for example rheumatism The absence from this discussion of the rheumatic diseases of the name of R Llewellyn J Llewellyn is difficult to understand Llewellyn, the writer of widely known works on rheumatism, arthritis, gout and fibrositis is an authority of international reputation who has lately introduced the vitamin cum sunlight deficiency theory of rheumatic conditions Dr Poynton does not once quote from him nor does Dr Comrie in his chapter on 'Arthritis" What is still more inexplicable is that Llewellyn's name is omitted from the index, otherwise a very full one As is right, Llewellyn is quoted on Malingering

Further, when lactic acid as a possible factor in the etiology of rheumatism is being referred to (p 66), no mention is made of the late Dr Percy Wilde of Bath, who devised a valuable 'pyretic couch' for the cutaneous elimination of the (hypothetical) lactic acid

On page 148, and again in the index, the name of Vallisnieri is misprinted

The statement on p 192 that Galen in *1538* narrated the instance of an orator who simulated an attack of colic to avoid making a speech is interesting in more ways than one Either the date should be A D 153 or Galen is, in a certain sense, still with us D F. F-H

The Genus *Lilium*

A Supplement to Elwes' Monograph of the Genus Lilium By A Grove Part 1 Pp v+viii+12+4 plates (London Dulau and Co, Ltd, 1933) 52s 6d

NO more worthy memorial to the late Henry Elwes could have been devised than the magnificent supplement to his monumental "Monograph of the Genus *Lilium*", the first part of which has just been published The supplement has very wisely been produced in the same form as the original monograph, published in 1880, and the plates by Miss Lilian Snelling are as faithful and as well reproduced as could be desired

Dame Alice Godman, who is responsible for the publication of this supplement points out in her foreword how fortunate it is that Mr Grove who had collaborated with Mr Elwes in the preparation of material for such a supplement, has been able to carry out the work to completion

Botanists and horticulturists alike join in congratulations to Mr Grove, who modestly quotes the words of Elwes in the first paragraph of his introduction, and applies them to himself, but they will not allow that these really apply to Mr Grove, who has devoted so many years to a detailed study of the lilies, and as a result of careful work is now rightly regarded as an authority on the genus

The supplement is to be issued in six or seven parts, and this first part contains a very informative introduction by Mr Grove—unfortunately on the dedication page his Christian name is given as Alfred instead of Arthur—in which he gives many interesting historical facts in addition to much valuable botanical information

Then follow the four plates included in this first part *Lilium Sargentiæ* Wilson, from Western China, with its lovely funnel shaped, pinkish white flowers, which are rosy purple on the outside—one of the few species which bear bulbils in the leaf axils, *Lilium Henryi* Baker with its orange coloured, nodding flowers with recurved petals—a species found in the Ichang Gorges, Central China, by the late Prof Augustine Henry, *Lilium rubellum* Baker, the lovely rose petalled lily from Japan, and *Lilium cernuum* Komarov, from Korea and Manchuria distinct among lilies for its nodding lilac coloured flowers and numerous linear leaves

The fine plates are accompanied by full descriptions both in Latin and in English and following these Mr Grove has given a very complete and lucid account of our knowledge of these lilies and the history of their introduction to cultivation

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Short Reviews

An Introduction to the Study of Map Projections By J A Steers Third edition revised and enlarged Pp xxiii+227 (London University of London Press Ltd, 1933) 8s 6d net

MR STEERS's useful little book on map projections, the third edition of which has recently been issued, is written for those students of geography who have only the most elementary knowledge of mathematics, and avoids all analysis and any mention of the calculus Subject to this self imposed limitation, the author succeeds, in general, in presenting to the beginner an accurate view of most of the useful projections, with some outline of recent work in this field of study The illustrations are good and some are ingenious, notably the plate showing a comparison of five zenithal polar projections The third edition differs from the second chiefly in the addition of two new chapters, one dealing with Col Craster's parabolic projection of the whole sphere and with related projections, and the other describing briefly some other new, or unusual, projections, such as Craig's retroazimuthal group, or Maurer's orthodromic or two point azimuthal projection

The method of presentation is most successful in describing the zenithal and conical groups and equal area world maps such as Mollweide's It is, of course least happy in dealing with Mercator's and other orthomorphic projections There are a few expressions which might be corrected in a fourth edition on page 5 it is stated that 'the azimuths will coincide with the meridians', and on page 110, with reference to Mercator's projection there is the remark that the sum of the secants from the Equator to that parallel must be found' The note on page 2 wrongly includes Fig 16

The book is well got up and is amply illustrated by plates and diagrams, the issue of a third edition within six years of the first publication, shows that there was an undoubted need for a book of this type and that it does meet the requirements of the non mathematical geographer

Reports of the Progress of Applied Chemistry Vol 18, 1933 Pp 770 (London Society of Chemical Industry, 1933) 12s 6d, to Members, 7s 6d

THIS important annual volume is modelled on the familiar plan of the series and fully maintains the customary high standard Not only is it almost indispensable to workers in the domain of technological chemistry, but also it offers to other scientific workers, and indeed to many whose work is not scientific at all, an excellent review of progress in one of the greatest of the world's industries The opening paragraphs of the chapter on fuel, for example, show how the chemist, in effecting economies and developing alternative sources, is quickly brought into contact with reverberations in the form of social problems and the incidence of taxation It is satisfactory to read that precautions taken in British gas works in regard to waterless gasholders are adequate to prevent another such disastrous explosion as that which occurred in Germany at Neunkirchen

In the chapter on textiles, reference is made to the ignorance displayed by the general public including some newspapers, about the conduct of the chief manufacturing industry of Great Britain, this industry is engaged in a struggle of serious national significance, and appreciation of its position can be based only on knowledge of its mode of existence Fortunately, in certain other branches of chemical industry, steady improvement is reported Thus in the iron and steel industry there is "quiet optimism", in the glass industry "improving tendencies , in the rubber industry ' encouraging aspects ' despite instability, in the leather industry improvement" The report on the food industry refers with concern to the unpleasant fact that a very large proportion of the world's inhabitants are seriously undernourished, and indicates the chemist's part in remedying this state of affairs But a few references such as these cannot adequately reflect the interest which the report provides A A E

Technique of Modern Welding By Prof P Bardtke Authorized translation from the second German edition, with additions and revisions by Prof Bardtke, by Harold Kenney Pp xi+299 (London Glasgow and Bombay Blackie and Son, Ltd, 1933) 15s net

IN recent constructional engineering there has been no more notable development than the application of welding Welded joints, to day, are used in bridges, boilers, ships, roofs, motor cars, aeroplanes and many other structures At first carried out by rule of thumb methods, a rational technique has been developed, symbols and codes have been introduced, standardised tests established and there is already an extensive literature on the subject To this literature this translation of a book by the works manager of one of the German State Railways is a valuable addition The main chapters deal with fusion welding, pressure welding, the applications of welding and the economics of welding There are also chapters devoted to testing, to accident prevention and to gas cutting Descriptions of the various types of plant are included and many useful hints are given on the welding of both ferrous and non ferrous metals The book is well printed and illustrated and contains an adequate index

Outlines of Organic Chemistry a Book designed especially for the General Student By Prof F J Moore Revised by Prof William T Hall Fourth edition Pp xiv+338 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd 1933) 16s 6d net

THIS book was written merely to serve as an introduction to organic chemistry and to serve as a guide especially to those who study the subject from a non professional point of view" It provides a coherent and straightforward treatment of the subject but considering the particular aim in view it is remarkable that the work conveys no sense at all of the historical or chronological development of the subject The account is formal and singularly impersonal so that for example, the fundamental account of stereochemical theory contains no mention of Pasteur Le Bel or van 't Hoff The experimental aspect of organic chemistry also receives little attention The book is well printed but sparsely illustrated British students will consider it expensive J R

The British Journal Photographic Almanac and Photographer's Daily Companion, with which is incorporated The Year Book of Photography and Amateurs Guide and The Photographic Annual 1934 Edited by George E Brown Pp 684+64 plates (London Henry Greenwood and Co Ltd 1934) 2s net

THIS almanac has been published as a book since 1861 Mr Brown has edited it since 1906 Year by year he has made it a very worthy daily companion for the photographer While it contains, in each issue brief working details of most of the common processes of photographic technique, it seems to keep thoroughly up to date By means of good indexes, which cover advertisements as well as text it has been possible to make the long series of volumes into a kind of encyclopædic work from which not only details of technique may be learned, but also the development of photography may be followed It can be recommended confidently to all who use photography

Das Problem der Gleichzeitigkeit Von Dr Karl Vogtherr Pp 196 (München Ernst Reinhardt 1933) 5 50 gold marks

ALL who desire to acquaint themselves with the attitude of a serious and well informed critic of relativity theory from the philosophical point of view may be recommended to read this book The author examines the postulates and axioms of geometry, time theory and kinematics, and the principles underlying measurements of space, time and motion and then discusses the determination of the simultaneity of events Although his conclusions are certain to be challenged by geometers and relativists alike, nevertheless his book will be found very interesting and stimulating, whatever may be the reader's opinions on the many contentious questions raised in it

Lord Avebury (1834–1913)

THE centenary of the birth of Sir John Lubbock, afterwards Lord Avebury, occurs on April 30 and the occasion should not be allowed to pass without grateful tribute to his memory. It is perhaps difficult for the younger generation to realise the distinguished position which that great Victorian held in the scientific world of his day. In the present era of specialisation many may underrate the claims to greatness of one who was an amateur naturalist and a popular writer. But a more careful consideration of his work and aims will show that he helped to lay those foundations of science and scientific education which has given the present generation of professional scientific workers the opportunities they now enjoy.

We must remember that in the days when science was not included in the ordinary school curriculum and was a negligible part of a university education, the advance of science was largely due to the work of amateurs, such as Charles Darwin, Sir John Lubbock the banker, Sir Joseph Prestwich the wine merchant, and Sir John Evans a paper manufacturer. Not that there was anything amateurish in the work of these pioneers. They were capable of intensive and fundamental researches and Lord Avebury's 'Monograph on the Collembola and Thysanura", published by the Ray Society, is sufficient proof of his capacity for thorough and detailed investigation, and will remain an authoritative and standard account of these groups of insects. It was the wideness of his interests, and not any lack of thoroughness, which both prevented Lord Avebury from continuing his researches in one branch of science and at the same time caused him to become an all round naturalist of remarkable attainments.

Lord Avebury's love of natural history dated from his infancy, and his mother, who for many years charged herself with his education, noted in her diary that his taste for natural history made him an acute observer. His father, an able mathematician and a fellow of the Royal Society, took an equally careful share in the early education of his son, and when the latter was at Eton repeatedly urged the authorities to include some science in the curriculum. Both parents had very definite views on education, and dissatisfied with John's progress at Eton, he was withdrawn at the early age of fourteen and a half and at fifteen years of age began life in the family bank, of which he became afterwards the head. But in spite of the exacting commercial duties, by working early and late, throughout his long business career he devoted himself to the acquisition of new knowledge, both literary and scientific. Thus, though Lord Avebury never went to a university, he acquired a wide culture and a deep insight into Nature. Living in the country and being a keen observer he devoted himself wholeheartedly to the study of botany and entomology. His residence at Down gave him the inestimable advantage of a close personal intercourse with Darwin, who appreciated the ardent and inquiring mind of his young friend and always held him in high esteem. There is no doubt that Darwin's kindly help was a great stimulus to young Lubbock, who frequently expressed his gratitude for the inspiration he received from Darwin. That he became one of the staunchest supporters of the 'Origin of Species' is not to be wondered at, and Darwin valued his support, for writing to him in 1860 he says: "I settled some time ago that I should think more of Huxley's and your opinion, from the course of your studies and from the clearness of your mind, than that of any other man in England".

It was Darwin who urged Lord Avebury's father to get his son a microscope, with the help of which his earliest researches on freshwater and marine Entomostraca and on *Daphnia* were carried out. On the strength of these investigations Lord Avebury was elected to the Royal Society in 1858 at twenty four years of age. With the encouragement of Darwin and Huxley he commenced his investigations on insects, which he carried on for many years and which culminated, after a series of important papers, in the publication of the monograph of the Collembola already referred to, and of two books, one on "The Origin and Metamorphoses of Insects" and the other on "Ants, Bees and Wasps". His work on the senses and habits of these insects was based on definite experiments and on observations carried out for many years in succession on ants imprisoned in earth between glass plates. His own observations on the habits of insects, and the stimulus of Darwin, who was engaged in his studies of self and cross fertilisation of flowers, directed Lord Avebury's attention to the visits of insects to flowers, which resulted in the publication of his 'British Wild Flowers considered in Relation to Insects". This was the commencement of a series of botanical books on "Flowers, Fruits and Leaves", on "Buds and Stipules", and lastly the comprehensive "Contribution to our Knowledge of Seedlings". In all three books he showed a keen insight into the morphological problems involved, and they will continue to be of the greatest help to botanical students.

Long before he had completed his entomological and botanical researches, Lord Avebury's active mind had been turned for a time into other channels, and his intimacy with Galton, Prestwich and John Evans had directed his thoughts to problems connected with the antiquity of man. A series of visits to France, Denmark and Switzerland gained him a sound and extensive knowledge of prehistoric mounds and implements which enabled him to become one of the leaders of anthropological research in Britain, as his "Prehistoric Times" and "The Origin of Civilisation and the Primitive Condition of Man" amply testify. Anthropology, indeed, became an abiding interest with him, and he did much to preserve the destruction of prehistoric remains by introducing into Parliament the Ancient Monuments Act of 1882. It is largely due to his energy and foresight that the monumental stone circle at Avebury was preserved from further destruction, and it is characteristic of his deep interest in the latter, that when he was elevated to the peerage he took the name of Lord Avebury.

For most business men, three absorbing hobbies, including the writing in connexion with them of important books, which ran into many editions, would have been more than sufficient to occupy their time and energy, but from boyhood Lord Avebury made systematic use of his time and worked early and late to forward the aims he had set before himself. Thus, when invited to become a candidate for Parliament he accepted the invitation, much to the dismay of Darwin and Hooker. The latter wrote to Darwin: "I gnash my teeth when I think of Lubbock going into Parliament. I grudge so good a man from Science." Darwin, who had been reading Lubbock's "Prehistoric Times", wrote to congratulate him on the book, and added: "I do sincerely wish you all success in your election and in politics; but after reading this last chapter you must let me say: Oh dear! Oh dear! Oh dear!' "

Lord Avebury had, however, set himself several definite aims as Member of Parliament. They were: to carry a measure to prevent a rapid destruction of ancient monuments, to promote the study of science in schools, to secure some additional holidays and to shorten the hours of labour in shops. We have seen how successful he was in the first of these aims. The others he was happily destined to see eventually realised. A year after entering Parliament he was successful in getting the Bank Holidays Act. How many, we wonder, of those who have recently enjoyed the relaxation of a fine Easter Monday realise to whom they owe this boon. His warm heart for those less favourably placed than himself led him to introduce successively and successfully the Shop Hours Regulation Act of 1886, limiting the hours of labour of young persons under eighteen years of age, an Open Spaces Act, a Public Library Act and a Shop Hours (Early Closing) Act. His effort to promote the study of science in schools did not lead to the promotion of any parliamentary measure, but nevertheless his persistent agitation led to the appointment of several Royal Commissions dealing with educational problems of elementary schools, public secondary schools and the universities.

On all these Commissions Lord Avebury voiced the growing need of scientific training, and there is no doubt that many changes in this direction resulted from the evidence given and the reports of the Commissions. Particularly in relation to the Royal Commission on Scientific Instruction at the Universities, the Commission recommended substantial capital as well as annual grants towards the cost of maintenance of the universities, and the grants now given by the Treasury to the universities may be traced to the report of this Commission and to the persistent efforts of Lord Avebury. By his numerous scientific publications on anthropological, entomological and botanical subjects he did much to diffuse an understanding and love of science among the general public, and the widespread interest which he created can be gathered from the numerous editions, often reaching double figures, which were called for. His energy in this respect was ceaseless. Darwin wrote to him once: "How on earth you find time is a mystery to me". But his business had made him methodical and he knew how to economise his time. Once when remonstrated with by his family for wearing elastic sided boots, he explained that one could learn a language in the time people took to button or lace their boots.

Lord Avebury felt driven to write and publish both his scientific and also his more popular books because of the intense enjoyment he personally got out of all his studies and of his keen desire that others should share in his pleasures. Even at home, when he had prepared a particularly good microscopic slide, he delighted to show it to the inmates of his house, including the maids and the page boy. No one had a keener appreciation of natural surroundings, and he desired that the minds of others should be awakened to this. Hence his publication of "The Beauties of Nature" and "The Wonders of the World we live in". Similarly in "The Scenery of Switzerland" and "The Scenery of England" he explained how it was based on the geology and physical geography of these countries. Lord Avebury had also a real love of good literature, and after addressing the Working Men's College on "The Choice of Books" he published his essay on "The Hundred Best Books" which excited much interest and comment and resulted in the publication of cheap editions of many books which were out of print. His aim was ever to promote the national culture of his fellow citizens. He wanted the general public as well as the schools to enjoy a stimulating intellectual atmosphere "charged with the oxygen of science", as Sir Michael Sadler has so aptly put it. It may truthfully be said that he succeeded in a great measure in effecting this by his personal efforts. The ever present benevolent urge combined with the simplicity and modesty of his bearing made him a most lovable character. The contentment of his life so full of good deeds, radiated a serene charm, which was felt by all with whom he came in contact. Scientific societies and educational institutions were eager to secure his services, and he probably held a record number of presidencies of learned societies and scientific institutions.

It is not possible within the limits of an article such as this to do more than touch upon some of the activities of so many sided a man Happily there is a good biography of him by H G Hutchinson and The Life Work of Lord Avebury edited by his daughter the Hon Mrs Grant Duff contains appreciations of his work by leading authorities of the various branches of science which Lord Avebury has enriched by his researches and publications When reading these we shall gratefully remember how much we owe to this great Victorian naturalist F E W

Stabilisation of Radio Frequencies

AMONG the problems which the rapid and extensive growth of radio communication has presented is that of keeping the frequencies of all transmitting stations steadily at their assigned values The success of the various international plans which have been formulated in recent years particularly for the control of broadcasting must ultimately depend upon the ability of radio engineers to adjust and maintain a wireless transmitting station at its correct frequency or wave length At the present time the primary standards of frequency which utilise either a tuning fork or a piezo electric crystal are amongst the most accurate of our physical standards With the aid of suitable equipment there is no difficulty in maintaining and using an accuracy well within one part in a million while the frequency standards of different countries are in substantial agreement to within a few parts in ten million Similar types of crystal or tuning fork oscillators can be employed to control the frequency of transmitting stations of appreciable power by the aid of somewhat elaborate power amplifying and if necessary frequency multiplying equipment This arrangement admirably serves the purpose of those stations operating on a single wave length and is used with conspicuous success in broadcasting stations and those used for long distance telegraphic and telephonic communication

There are however many cases particularly in connexion with ship and aircraft communication where it is necessary that the transmitting station shall be able to operate on a large number of different wave lengths and still maintain a high degree of accuracy and stability on each of these wave lengths It is usually an accompanying condition of such circumstances that the whole of the transmitting and frequency controlling apparatus must be much simpler than that which is employed at fixed land stations It is to meet such a demand as this that the Radio Research Board of the Department of Scientific and Industrial Research is at present studying the problem of developing a suitable valve oscillator which will provide frequency stability at a transmitting station without the necessity for elaborate equipment

As a preliminary to the experimental work which is now being conducted by the Radio Department of the National Physical Laboratory a thorough survey of the available information on the subject was made and this has recently been published* This résumé of the literature has been drawn up in two parts The first part consists of an essay on the subject as a whole and comprises in effect a brief textbook of the fundamental principles of this branch of radio science illustrated by reference to typical circuit arrangements used in practice The second part consists of abstracts of papers representative of the most important published work on the subject with commentary notes which are intended to bring each particular contribution into perspective with the whole

In attempting to classify the causes of frequency variations in simple valve maintained oscillators a distinction can be drawn between frequency variations due to changes of a purely electrical character and those due to changes of the physical configuration of the system A simple and admittedly inadequate analysis of the valve maintained oscillator indicates that frequency variation due to incidental changes in the valve and its circuits can be minimised by meeting certain conditions Various special circuit arrangements have been developed on these lines and the consequent frequency stabilities obtained are variously estimated at between one and one hundred parts in a million A more exact analysis shows that it is very difficult to maintain electrical oscillations by means of a valve without producing harmonics which have a detrimental effect upon the steadiness of the fundamental frequency Experimental data are lacking as to the quantitative significance of this effect which however may be minimised by means of circuits designed to reduce so far as possible the potential differences due to the harmonics generated Recent investigations have shown that the inter electrode capacitances of thermionic valves may be expected to vary with the space charge conditions of the valve which in turn will vary with supply voltage and oscillation conditions Since these inter electrode capacitances are included in the electrical circuit which determines the frequency of oscillation any variation in this capacitance will produce a corresponding variation in the frequency

An ideal valve oscillator is probably one in which the frequency of oscillation is determined solely by the inductance and capacity in the external oscillatory circuit In this case however it is evident that the frequency will be directly dependent upon any changes in the physical configuration of this circuit due to changes in atmospheric conditions. For example, changes in temperature of the inductance coils and condensers in the circuit will produce changes in the electrical values of these components to an extent depending upon the coefficients of expansion of the materials used in their construction. The limited experimental evidence so far available indicates that changes of frequency resulting from temperature variations may exceed fifty parts in a million per degree centigrade. To a lesser, but by no means negligible, extent, changes in atmospheric pressure will produce a change in capacitance of an air condenser by virtue of the alteration in the dielectric constant of air. A further factor to be taken into account in a complete study of the subject is the effect of the load circuit, which is coupled to the oscillator and by means of which the oscillations generated are put to practical use. A brief consideration of the relevant conditions indicates that in order to minimise the effect of the load circuit on the oscillation frequency, this circuit should be slightly detuned by an amount which depends upon its effective resistance.

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* Department of Scientific and Industrial Research. Radio Research Special Report No 13 Valve Oscillators of Stable Frequency a Critical Survey of Present Knowledge By F M Colebrook Pp vii+56 (London H M Stationery Office 1934) 1s net

In conclusion, the possibility of securing frequency stability in radio transmitting stations by the use of an automatic monitoring arrangement is discussed briefly in the report recently published. The scheme provides for the frequency of the transmitter to be adjusted directly to agree with that of a small power valve oscillator designed for a high-degree of frequency stability under no load conditions. If such a scheme can be developed successfully without undue complication of equipment, it may provide one solution to the problem of stabilising the frequency of a simple transmitter which has to be operated over a wide range of frequencies. The whole subject is, however, being investigated in a comprehensive manner, since more than one solution may ultimately be necessary to meet the conditions of practical radio communication.

Physiology of the Blue Whale

By Prof. AUGUST KROGH, Laboratory of Zoophysiology, University of Copenhagen

RATE OF GROWTH

IN the paper by Mackintosh and Wheeler, "Southern Blue and Fin Whales" ('Discovery Reports", I 1929), a graph is given showing the growth in length of the Blue whale from the fœtal state to maturity. In Laurie's paper, "Some Aspects of Respiration in Blue and Fin Whales" ("Discovery Reports", VII, 1933), graphs are given showing the relation between length and weight of Blue whales, and since this relation is remarkably constant, it becomes possible to calculate the weight of the young whales at different stages.

Such a calculation shows the new born Blue whale of 7 m. length to weigh about 2,000 kgm., while at weaning seven months later, the length has increased to 16 m. and the weight to 23 000 kgm. When the whales become sexually mature at two years of age, the females are on an average 23·7 m. in length and weigh 79,000 kgm. The period from weaning to maturity includes two summer seasons (about twelve months) in antarctic waters with abundant food, and one winter in more northern waters where food is scarce. The increase from 23,000 kgm. to 79,000 kgm. therefore takes place mainly or exclusively during the twelve months when they are in the antarctic. Laurie gives a table showing the composition of a 20 m. Blue whale. Assuming the same composition during the period of growth, the 56,000 kgm. increase should be distributed as follows:

			Fat		Protein	
	per cent	kgm	per cent	kgm.	per cent	kgm
Meat and entrails	59	33 000	6 5	2,150	23	7 600
Blubber	18 6	10 400	88	9,200	4	400
Bones	19	10 600	45	4 750		,
		54 000		16 100		8,000

Calories 150 mill. + 44 mill. = 194 mill.
Calories per day in 365 days = 540 000
" " 518 = 380 000

It may be of some interest to compare this rate of growth with that of a pig. The new born pig weighs about 1 kgm. After seven weeks' lactation, the weight is about 6 kgm. and, feeding with about 200 kgm. of skim milk and 300 kgm. of grain, it attains the weight of 90 kgm., at which it is converted to bacon at the age of six months. The food consumed corresponds to a little more than 1 million calories, and the increase in weight from weaning to 320,000 calories, or 2 600 cal. per day. Assuming an average weight for the growing pig of $\frac{6 + 90}{2}$ = about 50 kgm. and for the growing whale of $\frac{23\,000 + 79{,}000}{2}$ = about 50 000 kgm., it is seen that the growth of the pig per unit weight is about five times as rapid as that of the whale. The comparison should not, however, be made on the weight but on the surface basis, corresponding to the cube root of the square of the weight ($W^{2/3}$). When the whale weighs just 1,000 times the pig, the increase per day should be $1{,}000^{2/3} = 100$ times as large, but it is found to be 540,000 calories instead of 260,000, or just double that of the pig, in spite of the fact that the pig has its food served regularly, while the young whale is left to its own resources. It is a pity that the chemical composition of the crustacean *Euphausia superba* constituting the whales' staple diet is not known. It would be extremely interesting to know if whale fat is mainly derived directly from the food or mainly built up by synthesis.

METABOLISM, CIRCULATION AND RESPIRATION

On the assumption that the surface law is valid for whales and that the normal metabolism is

1,000 calories per sq m per day, Laurie arrives at the figure 275,000 calories as the resting metabolism of a 122,000 kgm Blue whale It is worthy of note that the assumption, for which good reasons are given by Kleiber ('Die Tierernährung", 5, 1933), that metabolism is proportional to $W^{3/4}$ instead of $W^{2/3}$ with a unit value of 72 cal per day, would raise the calculated metabolism to 460,000 cal It might, I think, be possible to arrive at a value for the metabolism by calculating the heat loss from an internal temperature of 35° C, a water temperature of say 5° C, measurements of the thickness of blubber and its properties as a conductor of heat A series of temperature determinations through the thickness of blubber of a freshly killed whale would enhance the value of such a determination

The metabolism of a whale is increased by its muscular movements in swimming Prof Carl Hansen, of the Danish Technical High School, has kindly calculated for me the towing resistance at various speeds of a 122,000 kgm whale, the surface of which he calculates as 230 m^2 He finds the resistance and horse power necessary at different speeds to be as shown in the accompanying graph (Fig 1) where *R* represents the resistance in kgm and *N* the necessary horse power At 3 knots the necessary power is 1 5 h p, at 5 knots it is 6 5 h p and at 10 knots 46 8 h p He assumes 100 per cent efficiency as a propeller for the tail, which he believes to be superior to any screw If I assume a 22 per cent efficiency for the muscular engine working the propeller, I find as a good approximation 10 litres of oxygen or 50 calories consumed per h p per minute It would be of great interest to have actual determinations of the towing resistance of whales at varying rates of speed, and it should not be very difficult to obtain such figures

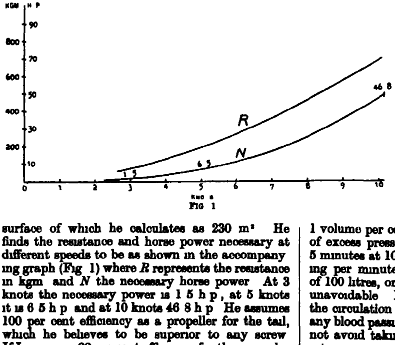

FIG 1

The assumed resting metabolism of 275,000 calories per day corresponds to 38 litres of oxygen per minute Assuming that the whale swims at an average rate of only 3 knots, we have a total metabolism of 53 litres of oxygen per minute We may suppose in the case of this whale, in accordance with the findings on man and other mammals that, at rest, about 40 per cent of the oxygen capacity (14 volumes per cent) of the blood is utilised, which gives us a circulation rate of very nearly 1,000 litres per minute A Blue whale can swim at the rate of 10 knots when harpooned This means a metabolism of a little more than 500 litres of oxygen per minute With such heavy work the oxygen utilisation may reach 80 per cent and the circulation rate would become 4,500 litres per minute

The capacity of the lungs is estimated by Laurie from their weight at the very small figure of 3,050 litres A better approximation is obtained by measurements of the thorax volume, subtracting the heart, and the weight of the lungs For a whale of 22 m this was estimated at 7,000 litres and I arrive at 14,000 litres as the most probable figure for the 27 2 m whale Careful measurements of the thorax volume of whales are among the chief desiderata for physiological calculation 14,000 litres of air would provide the whale with approximately 2,800 litres of oxygen or enough for 50 minutes at the estimated metabolism of 53 litres per minute

Because the possible thorax volume is evidently approximately proportional to total volume or weight of animal, while metabolism is proportional to some fractional power of the weight (probably between $W^{2/3}$ and $W^{3/4}$) large size is essential for the capability of prolonged diving

LIABILITY OF WHALES TO CAISSON DISEASE

In deep diving, the blood passing through the lungs becomes supersaturated with nitrogen About 1 volume per cent is taken up for each atmosphere of excess pressure Supposing the whale to stay 5 minutes at 100 m, the 1,000 litres of blood passing per minute would take up an extra amount of 100 litres, or 500 litres in all This is, I believe, unavoidable It seems to me inconceivable that the circulation should stop during deep dives, and any blood passing through the lungs could certainly not avoid taking up the corresponding volume of nitrogen

A slow circulation will reduce the rate at which nitrogen is absorbed, and to that extent large size is advantageous, but it will reduce also the rate at which the gas is given off at lower pressures Supposing the whale to take a series of dives to 100 m, staying at the surface each time only for the few seconds necessary to take one or two breaths, a progressive supersaturation of the blood and the tissues seems unavoidable, and, should the whale choose to stay at the surface for some time afterwards, nitrogen bubbles should appear both in the blood and in the tissues—in other words, the whale would be liable to a severe attack of caisson disease

The striking evidence presented by Laurie shows (to my mind conclusively) that serious supersaturation of tissue fluids with nitrogen does not supervene, but just how it is avoided is by no means clear Laurie has made the remarkable discovery of the nitrogen binding *X* organisms in the blood of whales, but, admitting everything he claims for them, their nitrogen fixation is far too slow to be an essential factor, the more so as the fixation requires oxygen, and in all probability not less and probably more than 1 volume for each volume of nitrogen The 100 litres assumed to be absorbed per minute at 100 m would therefore require 100 litres of oxygen, or almost double the volume necessary for the whale's metabolism proper This, I think, is outside practical possibilities

I suspect that the retia mirabilia of blood vessels present in all deep-diving mammals may have something to do with the mechanism for escaping caisson disease, but I must confess my inability to see how I suggest, however, that our knowledge of these structures, in spite of the valuable anatomical research done upon them, is too incomplete to make speculation worth while, and would point out that a detailed and also quantitative investigation of the retia is highly desirable

Obituary

Mr William Barlow F R S

WILLIAM BARLOW was born in Islington, London, on August 8, 1845, and inherited from his father, Frederick Barlow, a business dealing with estate and building property, by the exercise of notable acumen in affairs he realised the business and thus found himself early in life possessed of ample means Barlow was educated privately, he had a taste for physical science and marked mathematical talent, but cultivated the latter unsystematically and perhaps almost exclusively

Barlow thus found himself in his early thirties with an independence, with a genius for handling geometrical problems of a particular kind and with ample leisure to devote to the study of crystal structure, which had become the subject of his choice He had not, however, received that rigid disciplinary training through which most students of physics and chemistry acquire a broad sense of contemporary knowledge of the physical universe In some respects this was a hindrance but in others an advantage, it left a powerful intellect unhampered by authority and led a logical mind to pursue its inquiries into difficult and obscure paths which might intimidate the more conventionally trained Towards 1888 Barlow came into contact with Prof H E Armstrong, from whom he received much encouragement and help, he also met Mr (now Sir) H A Miers and the writer and acquired from them most of his knowledge of formal crystallography He then spent some time with his family in Germany and made the acquaintance of Paul Groth, the crystallographer, occupying himself with the geometry of crystal structure, on returning to England he devoted himself to crystallographic work of a theoretical kind until his death at Stanmore on February 28, 1934

In summarising the work of an unconventional genius, it is not easy to proceed chronologically, Barlow did not attack problems in the order which they would naturally take in a textbook or in the present notice His work on the homogeneous partitioning of space may therefore be first reviewed

For a century past the view has prevailed that crystal structure consists in the similar repetition throughout space of identical units without regard to their shape or constitution Continuing earlier work by Bravais and others, Sohncke in 1879 introduced the idea of a regular point system as one in which the pencils of lines drawn from each point of the system to all the remainder are congruent with each other, the regular point-systems if classified according to the position and nature of their axes of symmetry (whether screw axes or axes of rotation) are 65 in number The 65 Sohncke systems, if built up of mathematical points, do not account for all the types of symmetry represented by the 32 crystal systems, it will be seen at once that the structure of hemimorphous crystals, in which a polar axis is present, cannot be described by a Sohncke system without some further assumption, such as polarity of the points or of the component atoms or molecules

The development of Sohncke's work needed to provide a complete geometrical theory of crystal structure was undertaken independently by Schönflies, Fedorow and Barlow all three solved the problem but by different methods and the line of attack adopted by Barlow may be now briefly indicated Each Sohncke system is characterised by certain coincidence movements, these being translations and rotations about an axis of symmetry, which leave its appearance unchanged, further, a number of the Sohncke systems are enantiomorphous, that is, not identical with their mirror images Barlow duplicated the enantiomorphous Sohncke systems by intercalating the mirror image in such a way that the coincidence movements of the two component point systems coincide, he worked out the geometrical methods, three in number, by which this duplication can be effected The 65 Sohncke systems thus became increased by another 165 to a total of 230, these are known as the 230 space groups and represent all the types of symmetry possible in crystal structures Each of the 32 crystal systems corresponds to one or more of these space groups With the proof that the space groups number 230, the geometrical theory of crystal structure becomes practically complete and the foundation is provided upon which any mechanical or physical theory of crystal structure must be erected Whilst the methods used by Barlow in carrying out this difficult and laborious piece of work are perhaps less elegant than those of Schönflies, they offer certain advantages by the lucidity with which they reveal the geometrical properties of the space-groups

Although Barlow published his work on the space groups in 1894, he had for long been engaged on the second part of the problem of crystal structure, that of the mechanical nature of the structure (NATURE, 29, 186, 205, 1883) He assumed that equilibrium requires that the atoms composing a crystal structure shall be arranged in closest packing and showed that two closest packed assemblages of equal spheres exist, one of these has cubic symmetry and is known as the face centred cubic packing whilst the other has full hexagonal symmetry Modern X ray analysis has now shown that most of the metals assume these structures, although some are in the looser body centred cubic packing The recognition that equilibrium demands that similar spherical atoms shall arrange themselves in one or other of the two closest packed assemblages, and that these occur in many of the metals, was the first definite success achieved in associating specific geometrical structures with specific crystalline substances, the importance of this result has been but too little appreciated

In his paper of 1883 in NATURE, Barlow discussed the crystal structure of biatomic compounds, and suggested as one possibility for sodium chloride a body centred cubic arrangement in which one kind of atom lies at the cube centres and the other at the corners, this structure has now been shown by X-ray analysis to belong to cæsium chloride but not to sodium chloride It is of interest to recall Sohncke's objection to this structure, he says (NATURE, 29, 383, 1884) "Thus eight atoms of Na stand in exactly identical manner around an atom of Cl (and also eight atoms of Cl around an atom of Na) The atom of Cl seems consequently to be in equally close connection with eight atoms of Na, it has exactly the same relation to those eight atoms It appears therefore as octovalent, certainly not as univalent, for it would be entirely arbitrary to suppose any two neighbouring atoms of NaCl in an especially close connection and to take this couple for the chemical molecule of NaCl By this example we see that from Mr Barlow's point of view both the notion of chemical valency and of chemical molecule completely lose their present import for the crystallised state" This, which was an objection fifty years ago, is now regarded as one of the merits of the accepted cæsium chloride structure, Barlow's reply to Sohncke (NATURE, 29, 404, 1884) states the modern view

Barlow expanded his earlier notions on crystal structure in a long paper entitled "A Mechanical Cause of Homogeneity of Structure and Symmetry" published in the *Proceedings of the Royal Dublin Society* for 1897 under the auspices of Prof G F Fitzgerald, this provides a great deal of information as to possible symmetrical structures Later, with the present writer, the conception was introduced that the atoms, supposed spherical, occupy volumes in the crystal structure proportional to their valency and, in papers published between 1906 and 1910, a large mass of experimental crystallographic data was reviewed It was found possible, with the aid of the closest-packing valency volume hypothesis, to correlate many morphotropic relations with chemical constitution and crystal structure

In 1912, however, the first observations on the diffraction of X rays by crystalline substances were made and opened the way to direct methods for determining structure, these, brilliantly handled by W H and W L Bragg and their followers, have furnished precise experimental data as to the arrangement of the atomic centres in a vast variety of solid structures It is now clear that Barlow's mechanical theory was stated in too simple a form to be applicable to any but the most simple cases, it seems now impossible that crystal structures are, in general, close-packed assemblages of spherical atoms In this connexion it is significant to note that if the cubic closest-packed assemblage of equal spheres is symmetrically partitioned into tetrahedral groups of four spheres, the centres of these tetrahedral groups form the well known Bragg structure for diamond, the diamond may thus be pictured as a close packed assemblage of atoms which have the symmetry elements of the regular tetrahedron Although X-ray analysis has increased our knowledge of crystal structure in an astounding way and has proved a most powerful tool, it has not led to a mechanical theory of crystal structure, it reveals the atomic arrangement but offers no reason why the component atoms seem to be closely packed in some crystalline structures and only loosely in others The required mechanical theory of crystal structure may be found in some kind of generalisation of Barlow's conception of equilibrium conditions

Barlow was elected into the Royal Society in 1908 and was president of the Mineralogical Society from 1915 until 1918 He was a man of simple tastes, very happy in his family life and happy in his friends, he was an expert cabinet maker, and this was helpful in the construction of complex models of crystal structures It was never easy to follow his train of thought because he invented his own ways for attaining results, thus, he rarely used the classical methods of spherical trigonometry in crystallographic calculations, but devised special ones of his own for each case which arose Whilst Barlow's friends will remember his single-mindedness and his kindliness of heart, he will always rank among the master builders of the geometrical theory of crystal structure

W J POPE

DR FRED IBBOTSON

THE death of Dr Fred Ibbotson on February 5, at the age of sixty six years, brings a sense of personal loss to many metallurgists, especially to those connected with the steel industry of Great Britain As senior lecturer in the Metallurgical Department of the University of Sheffield until his retirement last year, he was responsible for training many students in metallurgical analysis, and his skill both as an analyst and as a teacher was largely responsible for the high standard of accuracy now reached in works manufacturing the higher classes of steels His course of lectures on the theory of analysis was an admirable introduction to the advanced chemistry of the less common metals and their salts

Dr Ibbotson made many improvements in analytical methods, and the textbooks in which he collaborated—"Steel Works Analysis" (with the late Prof Arnold), "Analysis of Steel Works Materials' (with H Brearley), and "Analysis of Non Ferrous Alloys" (with L Aitchison) are widely used A fellow townsman of Sorby, he was an early worker in metallography and translated the well known work of Goerens, whilst the papers of Prof Arnold in the *Journal of the Iron and Steel Institute* were often illustrated by his exquisite drawings of micro structures

Dr Ibbotson was born in Sheffield, but studied at the Royal College of Science in Dublin, of which he became an associate in 1887 He was a B Sc of London and a D Met of Sheffield Of striking appearance, great charm of manner and high character, he was greatly beloved by his students, only a very retiring disposition, which led him to shun meetings, prevented his reputation from reaching a wider circle C H D

WE regret to announce the following deaths

Mr Carsten E Borchgrevink, the Norwegian antarctic explorer, leader of the first expedition to winter in Antarctica, aged sixty nine years

Sir Richard Garton, G B E, governing director of the firm of Garton Sons and Co, brewing sugar manufacturers one of the founders of the British Empire Cancer Campaign, on April 22, aged seventy six years

Mr Richard Llewellyn Jones Llewellyn, an authority on rheumatism and its allied conditions, on April 19

Sir Max Muspratt, Bt, president of the Association of British Chemical Manufacturers in 1924, a leading figure in the heavy chemical industry, on April 20, aged sixty two years

Prof John M Poor, professor of astronomy at Dartmouth College, Hanover U S A who did much work on the orbits of comets, asteroids and double stars, aged sixty three years

News and Views

James Mansergh, F R S (1834–1905)

ON April 29 the centenary occurs of the birth of James Mansergh, the eminent hydraulic engineer, who, both at home and abroad, was well known for his schemes for water supply and sewage disposal His most famous work was that by which Birmingham was supplied with water from the Elan and Claerwen Reservoirs in Wales, 73½ miles away a work which was opened by King Edward VII on July 21, 1904 Mansergh was born in Lancaster After attending the local schools, he was at Queenwood College, Hampshire, for a short time, where Tyndall and Edward Frankland were among his teachers At the age of fifteen years he was articled to a firm of civil engineers in Lancaster and afterwards gained experience on railway construction in England, Wales and Brazil In 1866 he became a consulting engineer in Westminster, and from that time onwards specialised in water supply and sewage schemes It is said that he appeared more than six hundred times before Parliamentary committees, acted for three hundred and sixty municipalities or local authorities, wrote more than two hundred and fifty reports and gave evidence at about three hundred public inquiries Among the important schemes he carried out abroad were those connected with the water supply of Toronto and the sewage disposal of Colombo and Melbourne Entering the Institution of Civil Engineers in 1859 as an associate member, he became a vice president in 1895 and president in 1900 The following year his services as a hydraulic engineer were recognised by his election as a fellow of the Royal Society He died at Hampstead on June 15, 1905

Presentation to Prof Karl Pearson, F R S

WHEN the impending retirement of Prof Karl Pearson from the Galton chair of eugenics and from the directorship of the Biometric Laboratory at University College London was announced last year, it was felt desirable that steps should be taken to commemorate the pre eminent services which he had rendered to University College, to the University of London and to science, during nearly half a century An influential committee under the chairmanship of Prof L N G Filon, Vice Chancellor of the University of London, therefore decided to raise a commemoration fund for the purpose, Dr Ethel Elderton acted as honorary secretary and Dr David Heron as honorary treasurer of the fund As a result of the appeal then made, subscriptions amounting to more than £600 were received and at a dinner in Prof Pearson's honour at University College on April 23, under the chairmanship of Prof Filon, attended by some hundred subscribers, there were presented to Prof Pearson a bronze portrait plaque, a book containing the signatures of all the subscribers and a cheque for the balance of the fund,

£440, a Brunsviga calculating machine for his personal use had previously been presented to him The bronze plaque, of which a copy is to be presented to University College, and a small reproduction to each subscriber, bears the following inscription 'Presented to Professor Karl Pearson, M A, LL D F.R S, by students, colleagues and friends on his retirement after having been a Professor of University College, London, for forty nine years, in grateful commemoration of his research, teaching and inspiration" The balance of the fund is to be devoted to the completion or publication of such work of Prof Pearson or his pupils as he may select or to the advancement in any other way of the branches of science with which his name will always be associated Prof Filon, in making the presentation, paid eloquent tribute to Prof Pearson's distinction in so many fields, and was followed by Mr G Udny Yule, who gave very interesting personal reminiscences of work and holidays with K P

Joseph Priestley

THE recent issue of *Isis* (pp 81–97) contains an important paper by Mr W Cameron Walker on The Beginnings of the Scientific Career of Joseph Priestley", disposing of the incorrect views expressed by Priestley's biographers, such as, that his History of Electricity" was suggested by Franklin and that it led to his election as F.R S, that this distinction was the result of his electrical experiments, and so on The Canton Papers and certain letters—some facsimiles are given—in the Royal Society's library show that the writing of the 'History" was Priestley's own idea that he was elected F R S prior, not only to its publication, but also to his experiments, and that his friends secured his election with the view of increasing the sale of his book Priestley's own account, written long after these events, ascribed his election to his original experiments But the author is probably correct in hinting at a lapse of memory, since there is other evidence of this failing The most interesting document here is Seddon's letter of December 18, 1765, introducing Priestley to Price and suggesting in a postscript his introduction to Franklin As a result Priestley met Franklin and Canton, was elected F R S, was led to experiment in electricity, thence to the study of the conductivity of mephitic air', and thence to his classic chemical researches on 'airs' and to the discovery of oxygen—to the birth of modern chemistry Few postscripts' have had such historic consequences

Trevithick Memorials

A MEMORIAL to Richard Trevithick, the great engineer and inventor, was unveiled at Merthyr Tydfil on Thursday, April 19, by Mr David E Roberts, to mark in a fitting manner the historic journey of the first rail locomotive on February 21, 1804 The memorial is situated at Pontmorlais, close to what was then the entrance gate to Penydarren Ironworks, where Trevithick built the locomotive It ran down to the basin on the Glamorganshire Canal at Abercynon 9¾ miles distant, but the damage to the cast iron rails, which were of course only suited for horse traction, was such that the trials were not followed up The memorial itself is built of stone sleepers taken from the track, and incorporates also some of the old rails Its erection is the outcome of local effort backed by help from the Trevithick Centenary Commemoration in London The event was made a civic occasion, and a concourse of upwards of 3,000 spectators assembled for the ceremony The unveiling was followed by an address from Mr Roberts on the work, especially that in South Wales of Trevithick

THE second of the memorial tablets erected as a result of the commemoration last year of the centenary of the death of Trevithick, was unveiled at University College, London, on April 23 by the Hon Oliver Stanley, M P, Minister of Transport The tablet has been placed on the Gower Street side of the College to mark the site of the track laid down in 1808 over which Trevithick's locomotive *Catch me who can* ran This was the first rail locomotive to draw passengers, and the exact site of the experiment has only been determined after long inquiry The tablet, which bears a medallion of the inventor a representation of his engine and a suitable inscription, is of bronze, it is a bold and striking memorial and one which effectively attracts the attention of the passers by Prior to the unveiling, a meeting took place in the College which was presided over by Sir Murdoch Macdonald, M P, the chairman of the commemoration committee When asking Major Stanley to unveil the memorial, and the Provost of the College, Dr Allen Mawer, to accept the custody of it, Sir Murdoch said that often our great benefactors have reaped but posthumous honours and so it was with Trevithick, for although he died in 1833 it was not until fifty years later that his memory was honoured by the erection of a window in Westminster Abbey Methods of transport have developed greatly since Trevithick's time, but all our steam locomotives, great and small work on the principle first effectively applied by him

Cosmic Rays

PROF P M S BLACKETT delivered the Friday evening discourse on April 20 at the Royal Institution, taking as his subject Cosmic Rays" This fascinating subject started more than thirty years ago with the discovery that clean dry air at sea level is a slight conductor of electricity, it has now grown into one of the important branches of physics, and it perhaps may also be considered as an important branch of astronomy For whatever the final explanation of the origin of the rays is found to be, it is probable that their origin is of great astronomical significance The instruments with which the rays have been investigated have been the ionisation chamber, the counter and the cloud chamber, and experiments have been carried out with such apparatus all over the world and at very great heights above the ground and far below the surface The cosmic radiation is a part, really, of geophysics, to be studied not only in the laboratory but also everywhere that is attainable It appears from all these results that the earth is being bombarded by streams of positrons and electrons of very great energy These appear to come continually from outside our galactic system, but from where, or how they are produced, no one knows The study of the passage of these rays through the atmosphere has led to the discovery of exciting new phenomena The positron, first detected by Anderson in a cloud photograph, is now known to be one of the main constituents of the rays, and this new member of the group of fundamental particles has very great theoretical interest, since its experimental detection has shown the validity of Dirac's theory of holes' Very great interest is attached to the behaviour of the very fast cosmic ray particles while passing through matter The curious and striking phenomenon of the showers' still awaits explanation It is clear that one is here in a region of physics where quite new types of phenomena occur

Humour and Humanism in Chemistry

UNDER this title, Prof John Read, of the University of St Andrews, gave an address to the Alchemists Club of the University of Glasgow on February 28 One of the chief defects in the average science course or textbook he said, is the neglect of the human element He deprecated this omission, which he holds responsible for many of the misconceptions of men of science by their colleagues of arts and letters, who, from attending a limited number of strictly formal and impersonal lectures on science have often deduced that the man of science is of necessity cold, formal and aloof, narrow in outlook, insensible to the finer human emotions, incapable of expressing himself in the common tongue, devoid of humour and humanism, and a stranger to the humanities' In the course of a picturesque survey of selected aspects of historical chemistry, Prof Read claimed that the study of chemistry, if approached befittingly, may reasonably take rank beside the so called humanities', as a broadly educative, cultural, and humanising influence He re-defined humour in various terms as the golden thread running through the whole history of chemistry the real philosopher's stone—the universal catalyst The present generation of chemists, he remarked, are inclined to take themselves too seriously, like Liebig, Wöhler, and their more remote alchemical forebears, they should include a large pinch of humour and humanism in their curricula The narrowness of outlook which is becoming increasingly associated with the ultra specialistic trend of contemporary chemical research can be combated most effectively by the cultivation of an interest in the broader humanistic aspects of chemistry Those chemists who aspire to become leaders in the future should cultivate a discerning and sympathetic acquaintance with the past During the ensuing discussion, in reply to Prof T S Patterson, the speaker threw some new light upon the possible origin and interpretation of the enigmatical seventeenth century illustrations appearing in the *Mutus Liber*

74-in Telescope for the University of Toronto

THE issues of *Engineering* for March 9 and 30 and April 20 contain a fully illustrated description of the 74 in reflecting telescope now being completed by Messrs Sir Howard Grubb, Parsons and Co, at Newcastle for the David Dunlap observatory of the University of Toronto An account of the instrument was published in NATURE of October 14 1933 The observatory, which is being given as a memorial to the late David A Dunlap, of Toronto, by his widow and son is being erected on Richmond Hill, 800 ft above sea level a few miles north of Toronto The circular steel building and the 61 ft dome for housing the telescope were made by Messrs The Cleveland Bridge and Engineering Co, Ltd at Darlington, and these together with the main parts of the telescope were sent to Canada last year The polishing of the mirror is now in hand The telescope the largest in the British Empire and the second largest in the world, weighs about 50 tons, of which the moving parts account for about 35 tons The polar axis is 22 ft long and the declination axis 13 ft long, the driving wheel on the former having a pitch diameter of 8 ft with 960 teeth of 8 mm pitch The whole gives details of the driving and controlling mechanisms The disc for the mirror, of special Pyrex glass, was made by the Corning Glass Works, New York and when received at Newcastle weighed 2 tons 6 cwt For grinding and polishing the mirror a special machine has been made which allows the mirror to be tilted for testing purposes without being removed from the machine The telescope, it may be added may be used either as a Cassegrain or a Newtonian for which two mirrors 19 in and 20 in in diameter respectively are provided

THE David Dunlap Memorial telescope is illustrated in the issue of the *Sphere* dated April 21, which also includes photographs of the new 36 in Yapp reflector at the Royal Observatory, Greenwich Accompanying these illustrations is an article entitled Studying the Sun in Calcium Light' and several lunar photographs taken with the 100 in reflector at Mount Wilson, California

Scientific Publication and Bibliography

AN ambitious plan for scientific bibliography and publications is described in a memorandum issued by Science Service, Washington The plan is designed to eliminate some of the defects in our present system, such as the difficulty of publishing research results promptly or completely owing to the financial burden, and the inadequacy of much bibliographic work owing to lack of access to original papers, etc It is proposed accordingly to centralise all scientific publication, abstracting and similar bibliographic services, and to substitute a photographic type of duplication for printed reproduction of scientific papers or abstracts Under this scheme a research report, for example, submitted and accepted for publication, would be reproduced from the standard typescript form by some suitable method other than printing, and full copies of the report or paper would only be supplied to order. The author would, however, also provide a summary abstract, say, two hundred words in length, which after editing, if required, would be reproduced by the most suitable means and the abstract would be included in a weekly or monthly journal issued to all scientific workers desiring information in that particular field.

This scheme does not discuss the fundamental difficulty of overlapping, but obviously presupposes that one abstract could serve the needs of several related branches of science or industry. It also proposes to deal with the difficulty of indexing scientific literature by assembling all the necessary subject cards for each published article or report and using an adequate numerical classification together with mechanical finding and sorting devices, thus affording a comprehensive basis for bibliographic work. The scheme visualises a public utility association for the United States of America which could afterwards be developed on international lines. Despite the inherent difficulties in the project, and the fact that the international aspects are among the most important and difficult in the problem of dealing efficiently with scientific literature, it should not be lightly dismissed. Bold treatment on such novel lines may possibly lead to a rational solution of a problem which has so often been attacked half-heartedly.

Bureau of American Ethnology, 1931

In the forty-eighth annual report of the Bureau of American Ethnology for the year ending June 30, 1931, Mr. M. W. Stirling, chief of the Bureau, in making his usual report on the activities of his staff in the period under review, directs attention to archæological investigations carried out by him in Florida. Among the sites examined on the west coast was a large sand burial mound on Blue Hill Island, south of Key Marco, which was found to be of early post-Columbian Calusa origin. A number of structural features unusual in Floridan sand mounds was disclosed. Among them was a clay floor, six feet above the bottom of the mound, which gave evidence of having been the base of a temple structure. It was surrounded by post holes, in some of which the decayed remains of the wooden uprights were still in place. The ‘accompanying paper” of the report, which as usual takes up the greater part of the volume, does not on this occasion deal with researches in American ethnology carried out by members of the staff, but is a useful general index of the contents of the annual reports of the Bureau from their inception to date. It has been compiled by Dr. Biren Bonnerjea. Originally intended by Dr. Bonnerjea for his own use, the index has been adopted officially and published by the Bureau. As the early volumes cover the period in the 'eighties of the final resistance of the Indians to white control in the south-western States, they record much valuable material relating to the final stage of independent culture which the index will assist in preserving from oblivion.

Modern Street Lighting

The characteristic and peculiar colours of the discharge lamps used for street lighting have attracted much interest to this important public service. With the development and research departments of great companies behind it, this branch of lighting has made rapid progress. In a paper read to the Royal Society of Arts by J. M. Waldram on January 17, it was pointed out that the use of these lamps has led to material improvements in our knowledge, leading to a new technique. One of the immediate problems of street lighting is connected with the question of who is to pay for it. It is an anomaly that a national trunk road should be built, drained and maintained at the national expense, and the lighting left to local authorities, each lighting its section according to its own ideas and naturally being sometimes very limited as to the cost. The requirements of the motorist are the most difficult to satisfy. He has when moving at high speed to see every obstruction in the road many feet in advance, whatever the condition of the road surface. Claims have been made that certain lights have more fog-penetrating power than others, but recent experiments throw doubt on this. Experience shows that from the safety point of view, when driving, the spectral colour of the light matters little. In general, recent progress has been made mainly in the direction of lowering the cost of production of the light and thus making more light available, and in distributing it over the road in such a way that it is more helpful to both pedestrians and motorists.

Short-Circuit Testing Station

When an electric generator is accidentally short-circuited, huge currents are developed and unless the circuit breakers' act promptly, serious damage may be done to the generator and there is a risk of fire. Until a few years ago, practical experience was the only guide to the rating of these circuit breakers. The enormous currents required for testing purposes, in most cases, made the testing costs prohibitive. Proposals were made for a co-operative or national testing plant, but nothing materialised. In 1929 a private company, Messrs. A. Reyrolle and Co., Ltd., of Hebburn-on-Tyne, laid down their own testing station, which has proved capable of testing the largest circuit breakers used in Great Britain. They have erected a miniature power station which has a capacity of 1·5 million kilovolt-amperes. Any short-circuit conditions which might possibly occur in practice can be produced in their testing room. The generators are driven by 5,500 volt motors connected with the public supply mains. Very large transformers are used to produce the heavy currents required. The observation gallery is built of reinforced concrete and has slits in the wall fronting the test bay, through which the behaviour of the apparatus under test can be safely observed. A system of traffic signal lights and alarm bells is installed outside the test bay to give warning when a test is about to be made and when all is clear. Short-circuit phenomena can be observed in time intervals as short as two millionths of a second Messrs Reyrolle's plant is one of the largest and best equipped short circuit testing stations in the world A scheme has now been initiated whereby full facilities are provided for utilising this testing plant for the benefit of the electrical industry A company has been formed which will operate independently and will be in a position to issue national test certificates

A Piano with no Wires

ACCORDING to a recent report by Science Service, pianos are now being constructed in Kalamazoo, Michigan, U S A , with no strings or wires To produce the tones, strips of steel not more than a few inches long are made to vibrate electrically The new instrument, called a clavier, uses a piano keyboard to operate the strips producing the notes, which are practically pure tones These tones, which are almost inaudible, are picked up by magnetic induction and passed through an audio frequency amplifier The capacity of the amplifier is about ten times that of the average radio amplifier having a capacity of 30 watts The player therefore has at his command a tone ranging from a mere whisper to one that would balance an orchestra The impact noise sometimes audible in a piano is filtered out, and thus the pure tone is produced The piano was invented by Prof Lloyd Loar after experiments extending over several years Through the use of earphones, the piano student can practise his lessons without disturbing anyone, the sound being heard only by himself The tone volume can be varied over a wide range simply by turning a dial The operating devices occupy very little space, the clavier consisting of little more than keyboards

Ipswich Museum

AN appeal on behalf of the Ipswich Museum has been issued by Mr J Reid Moir, its president The Museum is not well provided with exhibits illustrating the culture of the bronze age , but it now has the opportunity of acquiring an exceptional collection of bronze implements, many of which were found in Suffolk, at a cost of £100 The collection is at present on view in the Museum Mr Reid Moir, in issuing his appeal, does not confine himself to this immediate object , he takes a long view of the situation Availing himself of the occasion, he suggests the institution of a body of Friends of the Museum" who might collaborate in its work in various ways, and might, by subscription, provide a fund for use in emergencies which the provision from municipal funds could not meet for various reasons The case for the local museum as a centre of regional scientific and historical studies is ably stated in the appeal and needs no further elaboration here On the question of general principle, however, it may be pointed out that any proposal such as that made by Mr Reid Moir, which helps to broaden interest among the local public in the function of its museum, deserves every encouragement Without desiring to relieve the municipality, as the local education authority, from any responsibility that may be imposed upon it for the maintenance of the general intellectual level of its area, it must be admitted that occasions frequently arise in connexion with the work of a museum in which voluntary effort financial or other, is salutary and expedient, or even necessary, to supplement the official obligation of the municipality

Grassland and Grazing Research

Two new bulletins in the Herbage Publication Series have been issued by the Imperial Bureau of Plant Genetics at Aberystwyth The first, entitled Grazing"(Bull No 10 1s 6d), consists of a collection of papers read at the British Association meeting at Leicester in 1933, each of which approaches the subject from a different aspect The grazier's problems are put forward from a practical man's point of view, while the effect of the stock on the sward is considered in the light of experimental evidence The Bureau has for some months been collecting information regarding the technique employed in pasture and grassland research in Great Britain and certain dominions, and the other bulletin ('Technique employed in Grassland Research in New Zealand , Bull No 11 3s) is the first publication on the subject Questions of strain testing and building in grasses, clovers or lucerne, the breeding methods employed and the necessary corollary—the certification of herbage seeds—form the subject of several of the papers The measurement of pasture production is considered in detail A modification of the technique formerly described as 'alternate mowing and grazing' is put forward, while the lay out of the experiments, the stage at which cuttings should be made, and the technique of stock grazing trials are among other major points dealt with Reference is also made to two laboratory tests which have proved useful in conjunction with field work In the first place the prussic acid content has proved valuable as a means of distinguishing between different types of wild white clover, while screened ultraviolet light has been successfully employed in rye grass type determination

Russian Studies of Crop Plants

THE material collected by Dr Klinkowski on the ecological distribution of lucerne types has been translated and published in an abridged form as Bulletin No 12 in the Herbage Publication Series of the Imperial Bureau of Plant Genetics ("Lucerne Its Ecological Position and Distribution in the World ' Aberystwyth I B P G , Agricultural Buildings 3s 6d) Lucerne is the oldest forage plant known and originated from a number of regions of a steppe' character The routes along which the plant migrated are traced, and the history of its development and the importance of the crop at the present time described for 45 different countries The geographical distribution of the types of cultivated lucerne in Europe, Asia and North Africa is also dealt with A further publication, "Plant Breeding in the Soviet Union", has been issued jointly by the Cambridge and Aberystwyth Sections of the Imperial Bureau of Plant Genetics (3s 6d)

White Pelicans of Western America

WHERE formerly there were more than seventy nesting colonies of white pelicans in western Canada and the United States, there are now but seven large colonies Of these, five are in Government protected areas, a fortunate circumstance, since although there still exist 20,000–25,000 of these birds in the United States, their continued existence is not so secure as the numbers might suggest. The danger which most threatens the species according to Ben H Thompson (Science Service, Washington, D C), is the draining of lakes where the nesting islands exist, but there has also to be taken into account the retaliation upon nests and eggs by fishermen who object to the pelicans destruction of fishes, notwithstanding that in most places the birds have been found to feed mainly upon fishes not good for sport or food A third line of control was practised for some time in Yellowstone Lake, on account of the part taken by pelicans as carriers of a trout parasite, but that policy has been given up, and the Yellowstone Park birds are now fully protected

Museums Association

THE report of the Council for 1932–33 makes very satisfactory reading The membership rose to 801, and is now really representative of museum interests throughout Great Britain. Income for the year at £2,785, was a record, the subscriptions of members exceeding by £268 those of the preceding year, and the net credit balance for the year was £496 The work of the Association has followed the lines of recent years Co operation with the Carnegie United Kingdom Trustees in the allocation of museum grants has been continued, and now all applications for grants must be made in the first place to the Association A successful training course for museum curators was held at Manchester, the annual conference of 1932 at Birmingham, and there is the great venture of an Empire survey of museums which began in 1931 (*Museums J* , 33, 206 , 1933) The same number of the *Journal* contains an account of the very successful conference of 1933 at Norwich

Solar Physics Observatory, Cambridge

THE annual report of the Director of the Solar Physics Observatory at Cambridge shows that a satisfactory state of progress obtains at that institution (University of Cambridge Solar Physics Observatory Twenty first Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1932 August 1—1933 July 31 Pp 3) The 3 ft reflector is at last being put to regular use, and as a spectrograph will be obtained for it in the near future, we may look forward to a notable addition to the somewhat slender amount of stellar spectroscopy carried out in Great Britain The Solar Physics Observatory has recently acquired additional solar apparatus in the form of a fine train of prisms by Hilger There is now a good collection of spectrographs at the Observatory As in past years, a number of physicists from the Cavendish Laboratory have gone out on the Madingley Road and worked at the Observatory

Bibliography of Cossar Ewart's Works

PROF J H ASHWORTH and Dr F Fraser Darling have prepared a ' Bibliography of the Works of James Cossar Ewart ', who died on December 31 last (Supplement to Animal Breeding Abstracts vol 1 Edinburgh Oliver and Boyd Separate, 6d net) The list, which contains no less than 141 titles of papers and books by Cossar Ewart alone or in collaboration with others is a story of a long and active life of scientific investigation covering a wide range of work, from minute anatomy to animal breeding The last reference is to a letter on The Coat of Sheep ' in NATURE of March 19, 1927 , it is also of interest to note that nine of Cossar Ewart s papers to the Royal Society of Edinburgh are represented by title only, so that the abstracts published in NATURE are the only records of their subject matter

Academic Assistance Council

REFERENCE has been made in our columns from time to time to the work of the Academic Assistance Council, one of the functions of which is to assist men of science and letters who have been displaced during the political changes in Germany of the past year or so We understand that the Council has now compiled a list of such displaced scholars, with information as to whether they have succeeded in obtaining temporary or permanent posts The list is to be revised from time to time and sent to academic committees and appropriate institutions The Council, the address of which is c/o Royal Society, Burlington House, London, W 1, is prepared to give further information about the movements of those on its lists in reply to responsible inquiries

The Pasteur Institute of Southern India, Coonoor

THE annual report of the Director, Major K R K Iyengar, of this anti rabic Institute for the year 1932 has recently been issued Patients treated at the Institute numbered 566, with 4 deaths, a mortality rate of 0 7 per cent In addition, the anti rabic vaccine is now issued to 107 centres in the Madras Presidency and elsewhere, and at these 8,452 persons are reported to have received a complete course of treatment, among whom were 34 deaths, a mortality rate of 0 4 per cent Semple's carbolised sheep vaccine was used throughout the year, and 144,900 doses of this vaccine were issued , in addition to the human patients, 194 animals were also treated No record of research work appears in this report

The Apennine Tunnel

ON April 22 the King of Italy opened the new railway line joining Bologna and Florence Known as the 'Direttissima", this line is 21 miles shorter than the old line known as the 'Porretana" The total distance is 61 miles, of which 23 miles are underground Many bridges and viaducts have had to be constructed but the outstanding feature is the Apennine Tunnel, 11 miles 882 yards in length, which is the longest tunnel in the world with a double track The Simplon tunnel is slightly longer, but this consists of two parallel tunnels each with a single track The Apennine tunnel is a straight line for the whole length and, half way through, a station has been built with four lines for manœuvring purposes Electric traction is being used, the locomotives taking direct current at 3,000 volts The total cost of the line has been about £13,000,000, while the saving of time on the journey between Bologna and Florence is about one hour and a half

Rothamsted Experimental Station

OF the £30,000 required for the purchase of the land on which stands the Rothamsted Experimental Station, £26,700 has now been given or conditionally promised The sum of £3,300 remains to be raised before May 12 in order that the Station may claim the generous donation of £15,000 from Mr Robert McDougall and £5,000 from the Sir Halley Stewart Trust, which will complete the purchase fund Farmers and all interested in agriculture in its practical, technical or educational aspects are cordially invited to visit the Rothamsted and Woburn plots at any convenient time between the beginning of May and the end of October Mr H V Garner and Capt E H Gregory will be in charge of the demonstrations, and there is ample material at either of the farms to occupy a full day All communications and requests to visit the Stations should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden

Announcements

SIR ARTHUR EVANS has been awarded the gold medal of the Society of Antiquaries for "his distinguished services to archæology" This is the first award to be made of the medal

BRIGADIER GENERAL SIR PERCY SYKES has been awarded the Gold Medal of the Royal Empire Society for his recently published book "A History of Exploration from the Earliest Times to the Present Day"

PROF C V BOYS will deliver the nineteenth Guthrie Lecture before the Physical Society on May 4 at 5 p.m The title of Prof Boys's lecture will be "My Recent Progress in Gas Calorimetry"

THE third Spiers' Memorial Lecture of the Faraday Society will be delivered at the Royal Institution on May 16 at 5 30 p m by Sir William Bragg, who will take as his subject "Molecule Planning"

AT an ordinary meeting of the Chemical Society to be held on May 3 at 8 p m, a discussion on "Unicellular Chemistry" will be opened by Dr J Vargas Eyre Those invited to take part in the discussion include Dr E F Armstrong, Dr W G Bennett, Prof J C Drummond, Dr H B Hutchinson and Miss M Stephenson

SIR CHARLES PEERS, chief inspector of ancient monuments in 1913–33, has been appointed by the Lords Commissioners of the Treasury to be a trustee of the London Museum

DR R MADWAR has been appointed director of Helwan Observatory, near Cairo, in succession to Mr P A Curry, who is the Deputy Director General of the Physical Department, Ministry of Public Works, Egypt

THE annual meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, S W 1, on May 31–June 1 The autumn meeting of the Institute will be held in Belgium and Luxembourg on September 10–14

W JUNK, 68 Sachsische Strasse, Berlin, W 15, has just issued Catalogue 85, "Periodica Iconographiæ Rara et Curiosa" dealing with books on science and natural history The first section includes sets of periodicals, mainly foreign Iconographiæ contains chiefly coloured plate books, including several botanical rarities The last section has books on all branches of natural science, both standard modern works and earlier works of historical interest

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —An assistant lecturer in geography in the University of Manchester—The Registrar (April 30) An assistant master to teach mathematics in the School of Art and Technology, Chelmsford—The Clerk to the Governors, School of Art and Technology, Chelmsford (April 30) A chief technical assistant in the Department of Economics, Edinburgh and East of Scotland College of Agriculture—The Secretary, 13, George Square, Edinburgh (May 4) An assistant master to teach practical drawing in the Walton Junior Day Technical School, Liverpool—The Director of Education, 14, Sir Thomas Street, Liverpool 1 (May 4) A lecturer in bacteriology and assistant bacteriologist in the Public Health Laboratory, University of Birmingham—The Secretary (May 10) A veterinary surgeon in the Public Health Department of the Corporation of London—The Town Clerk, Public Health Department, Guildhall, E C 2 (May 10) A principal of the Central Municipal Technical School, Liverpool—The Director of Education, 14, Sir Thomas Street, Liverpool 1 (May 14) A teacher of mechanical engineering in the Central Municipal Technical School, Liverpool—The Director of Education, 14, Sir Thomas Street, Liverpool 1 (May 14) A demonstrator in physiology in the University of Liverpool—The Professor of Physiology (May 14) A Ramsay Memorial professor of engineering at University College, London—The Academic Registrar, University of London, S W 7 (May 23) A University professor of pharmacology at University College, London—The Academic Registrar, University of London, S W 7 (May 25).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Production of Positive Electrons by β-Particles

In a previous note[1] we described some experiments carried out with a weak source of radium placed inside an expansion chamber, and showed that the ordinary β radiation is accompanied by an emission of positrons It is quite impossible to ascribe the origin of these positive electrons to the internal conversion of γ rays or to any other known mechanism by which positively charged particles are created It seemed to us to be most plausible to assume that the appearance of these positively charged particles is closely connected with the phenomenon of β-disintegration However, more recent experiments have shown that the number of positrons depends to a large extent upon the nature of the walls surrounding the source examined

In a series of consecutive experiments with the same source of radium, the latter was alternately enclosed in either a lead or a carbon tube with different thicknesses of wall provided with different slits for the escape of the β rays With a carbon tube the number of positrons observed was two to three times greater than in the case of a lead tube This would lead to the conclusion that the emission of positrons is due, at least in part, to the bombardment of the walls by β rays

We verified this assumption in the following way The glass tube containing the active deposit, and surrounded by another tube of lead, was filled with pulverised carbon , in this case we observed a threefold increase in the yield of positive β rays (each time compared with the yield of ordinary β rays due to disintegration escaping through the given aperture)

Quite conclusive evidence was obtained by using a lead cylinder with walls 4 mm thick and internal diameter 6 mm A window 4 mm wide in the walls was closed by a carbon filter, 3 mm thick, for absorbing any positrons emitted by the active source, and for stopping all the ordinary β rays of energy less than *c* 1,000 ekv Under these conditions, the carbon filter emits very fast positrons (12 tracks with an energy between 200 ekv and 700 ekv , 7 tracks with an energy between 700 ekv and 1,200 ekv) their number constituting 5–10 per cent of the total amount of β rays which *penetrate* the filter

If we assume, on the basis of the present data on the absorption of β rays, that all the β rays of initial energy above *c* 1,000 ekv are able to penetrate the filter, and that these are the only rays which are effective, the results obtained must mean that, on the average, one positron corresponds to every 10 or 20 β particles and that the radius of the 'effective cross section' is of the order of 10^{-12} cm

The number of β particles which strike the filter, and are responsible for the appearance of positrons, may exceed the number of particles which emerge However, if we take into account the geometry of the experimental arrangement as well as the intensity of the source under examination, we shall be justified in concluding that the percentage yield of positrons is scarcely less than 2 per cent, the critical energy being taken as 1,020 ekv In this case the radius calculated for the effective cross section is not less than $0\ 5-1 \times 10^{-12}$ cm per atom, which exceeds the corresponding value for the γ rays of thorium C″ some ten times

Thus it is obvious that the above phenomenon has nothing in common with the mechanism considered by Furry and Carlson[2] We here encounter an entirely new relativistic effect which is outside the scope of the present theory

It may be added that the above results are in good agreement with previous observations made by one of us[3]

At the present moment it would be premature to decide whether the positrons are emitted by the radioactive substance itself The observed facts seem to indicate that the output of positrons is greater for the lighter elements Definite conclusions must be deferred until new experiments have been carried out, since the geometrical conditions up to the present could not be controlled sufficiently

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[1] D Skobeltzyn and E Stepanowa NATURE 133 565 April 14 1934

[2] W H Furry and Y T Carlson *Phys Rev* 44, 237 1933

[3] D Skobeltzyn NATURE 133 23 Jan 6 1934

Isomorphism and Chemical Constitution Constitution of Formic Acid and Formates

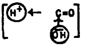
That formic acid differs from its higher homologues (acetic, propionic, etc) in many salient chemical characters is well known to chemists The break in the serial order as regards the absorption curves of the saturated monobasic fatty acids has been observed in the case of formic acid by V Henri, Hantzsch and Wright

The reducing character of formic acid, generally explained by the presence of an aldehydic group in the molecule, as distinguished from acetic acid and its homologues, the absence of a chloride and anhydride corresponding to acetyl chloride and acetic anhydride, the acid character of its nitride (HCN) differing from the indifferent nitrides of homologous acids, the strength of the acid twelve times stronger than acetic and propionic acids as shown by the affinity constants derived from electrical conductivity (Ostwald), have rightly induced Richter to differentiate it from acetic acid and its homologues Dr P B Sarkar, working in the inorganic department of my laboratory, has, in continuation of his work on chemical homology and isomorphism[1,2], recently arrived at the conclusion that these discrepancies are to be sought for in the difference in the constitution of the acid itself In other words, in the case of formic acid, the ionisable hydrogen is not the hydrogen atom of the hydroxyl group, as in the case of other fatty acids, but the hydrogen attached to the carbon atom

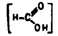
The classical synthesis of formates from CO and KOH is explained by Dr Sarkar on the modern electronic conception in the following way :

$$:C \equiv O: + K^{+} + \bar{O}H \longrightarrow K^{+} + \left[:C{=}O\right]^{-}$$

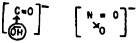
The hydroxyl ion co-ordinates with the group CO to which it imparts an univalent negative charge and thereby forms a complex anion (formate ion) The so-called bivalent carbon atom in this anion has really a lone pair' of electrons free Dr Sarkar has proved that the undissociated formic acid and its esters are not reducing although they contain the aldehydic group It is the formate ion that is reducing owing to the presence of a lone pair' of electrons in the carbon atom The undissociated acid, according to him, is of the constitution



In this form it is indistinguishable from the ordinary formula



as is evidenced by the Raman spectra On the basis of this hypothesis, Dr Sarkar deduces that the structure of the formate ion is almost identical with that of the nitrite ion



These two ions are isosteric and isoelectric and as such should exhibit isomorphic relations

Though barium formate crystallises anhydrous and barium nitrite with one molecule of water of crystallisation, Dr Sarkar has been able to prepare the mixed crystals of

1, barium (formate, nitrite) barium (nitrite formate), H_2O

2, Strontium formate with strontium nitrite

3, Zinc formate with zinc nitrite though the latter cannot be isolated in the free state

4 Cadmium formate with cadmium nitrite (miscibility small)

He has also prepared the double salts of the formulæ

Mg $(COOH)_2$, 2 hexamethylene tetramine, 10 H_2O
Mn $(COOH)_2$ 2 hexamethylene tetramine, 10 H_2O

perfectly isomorphous with the corresponding nitrites of magnesium and manganese prepared by Scagliarini[3] Further investigation regarding the double and triple formates and their comparison with the corresponding nitrites is in progress

To corroborate the above constitution of the formate ion, the examination of the Raman effect of barium formate in the solid state has been undertaken and is expected to throw additional light on the constitution

Detailed investigation will be published in the *Journal of the Indian Chemical Society*

P C RÂY

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92, Upper Circular Road,
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March 12

[1] NATURE 124, 480, Sept. 28, 1929
[2] NATURE, 126, 310, Aug 30 1930
[3] *Att. R Accad Lincei* (5) 21, II 88-92

Conductivity-Temperature Curves of Paraffin Wax

IT is usually supposed that the conductivity of dielectric materials increases continuously with increase in temperature The only recorded exception to this normal behaviour appears to be by Gemant[1], who found that the D C conductivity of a heavy cable oil decreased temporarily from − 40° to − 20° C I have recently observed a similar peculiar phenomenon, together with a hysteresis effect, in D C conductivity measurements over the temperature range from 0° to 50° C on a sample of paraffin wax (melting between 45° and 55° C) The results of a cycle of measurements under a continuously applied voltage gradient of 500 volts per cm are shown in Fig 1 Commencing at the point *A* the temperature was lowered to *B*, then raised at a rate of about 1° C in 5 minutes along the curve *BCD* and finally decreased at the same rate along *DFB* On regaining room temperature very slowly from *B* the conductivity had risen to *F*, and with temperature rise from this point followed the curve *FGD* On subsequent slow cooling to room temperature the conductivity attained the value *H*

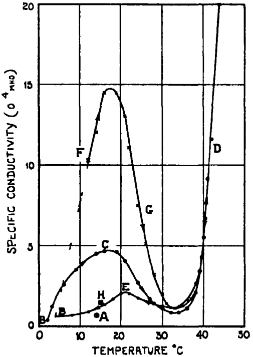

FIG 1

A discharge current, characteristic of dielectric absorption, lasting usually for from 1 to 2 minutes, was obtained on condenser short circuit immediately after a period of charge Measurements at 10 seconds after short circuit showed that the current magnitude at this instant passed through a maximum during temperature rise at 12° C and disappeared in the region of 55° C

A satisfactory explanation of the peculiar variations in structure responsible for the phenomena is not possible until further experiments have been carried out, but it is probably concerned with the presence in the wax, at temperatures below the 'solidifying' point, of a solid crystalline network among which is interspersed a liquid phase In consequence of adsorbed ions, the boundary surfaces of the two phases would have a greater conductivity than either phase, and where continuous, would form highly conducting bridges between the electrodes

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March 12

[1] A Gemant, Z Phys 75 613 1932

Calcium Sulphate Hemihydrate

Much attention has been given to calcium sulphate hemihydrate since it was recognised as the active principle of plaster of Paris, but its characteristics as a crystal species have hitherto remained somewhat vague

Several workers have reported on the preparation of the pure substance in the wet way by various methods, but always in the form of excessively small crystals It has now been found possible to grow crystals of hemihydrate' of a thickness of 0 5–1 mm and length of 3–4 mm from solutions of calcium sulphate in hydrochloric, sulphuric, or nitric acids under the proper conditions as to dilution of the solvent and temperature These crystals belong to the trigonal system and consist of the hexagonal prism 1010 capped by an obtuse rhombohedron 0112 and terminated by small developments of the base 0001 The axes have lengths $a = 6\ 76$ A and $c = 6\ 24$ A, so that three molecules are comprised in the unit cell, the density of the crystal being not far below that of anhydrite Details will be published in a forthcoming paper

In its air-dry condition the crystal usually contains no more than 4 0–4 5 per cent of water, corresponding rather to 3 $CaSO_4\,H_2O$ than to 2 $CaSO_4\,H_2O$ The moisture content of hemihydrate' has, however, been shown by Linck and Jung and others working upon less well defined materials to be held in the same way as that of zeolites This is now confirmed with the trigonal crystals, which may be made to give up water to within a tenth per cent or less of complete dehydration without losing form or transparency, on exposure to moist air they then gradually regain the original degree of hydration On dead burning' they are converted into pseudomorphs consisting of ordinary anhydrite

Brought into contact with water, the crystals yield solutions supersaturated with respect to $CaSO_4\,2H_2O$, though the effect is not so striking as with plaster of Paris, in a short time bunches of dihydrate needles are seen growing out of favoured spots on the hexagonal prisms

It seems, then, that anhydrite is dimorphous, we have the orthorhombic, comparatively inert modification, and a trigonal one stable only up to 200° or thereabouts, which can take up water zeolitically The behaviour of this latter in contact with water is what causes plaster to set There may well be no essential difference between the 'soluble anhydrite' and the 'hemihydrate' accepted in the literature of calcium sulphate

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April 9

The Value of e/m

Eddington[1] originally proposed the relation $hc/2\pi e^2 = 136$, and later[2] revised this to 137 Still later he proposed[3] a second relation, namely, the ratio of M, the mass of the proton, to m, the mass of the electron, is 1847 6[4] This second relation, combined with the value of the Faraday and Aston's mass of O^{16} leads[4] to $e/m = (1\ 77031 \pm 0\ 00014) \times 10^7$ E M units If, finally, one assumes the correctness of Bohr's formula for the Rydberg constant, there results[4], $h = (6\ 5490 \pm 0\ 0011) \times 10^{-27}$ erg sec, $e = (4\ 775855 \pm 0\ 000048) \times 10^{-10}$ E.S units

Bond[5] has very recently noted that the best experimental value of e/m, which he takes to be 1 759, is approximately 136/137 of Eddington's calculated value This new relationship is, however, closer than Bond states, since 136/137 (1 77031) = 1 7574, and the best experimental value is now actually 1 757 Thus Dunnington[6], from a new magnetic deflection method for free electrons, obtains 1 757 ± 0 0015 Gibbs and Williams[7], from the interval of corresponding $H^1\alpha$ and $H^2\alpha$ spectral lines obtain 1 757 ± 001 Kinsler and Houston[8], from the Zeeman effect of Cd and Zn lines, get 1 7570 ± 0 0010

The method used by Kretschmar[9] yields not e/m but $e/m\,(e^{4/3}/h)$[10] The observed value of this relation combined with Bohr's formula for the Rydberg constant leads to $e/m - 1\ 7564$ if the oil drop value of e (4 768) is assumed correct, and to $\sim 1\ 760$ if the value of e ($\sim 4\ 803$) deduced from grating values of X ray wave lengths is assumed correct These last two results are based on a recalculation of Kretschmar's observations by me, using improved auxiliary data Hence Kretschmar's work leads to a value of e/m entirely consistent with other recent work if one assumes the correctness of the oil-drop value of e 4 768 but not if the grating value, 4 803, is used

If the reader will pardon an additional intrusion into the popular domain of numerology[11], it may be noted that 4 803/4 768 = 137/136, to one part in 10^5

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March 22

[1] A S Eddington Proc Roy Soc A 122, 358 1929
[2] A S Eddington Proc Roy Soc A, 126, 696 1930
[3] A S Eddington Proc Roy Soc A, 134, 524 1931
[4] See R T Birge Phys Rev, 40 319 1932
[5] W N Bond, Nature, 133, 327, March 3 1934
[6] F G Dunnington, Phys Rev 43, 404, 1933
[7] R C Gibbs and R C Williams Phys Rev 44, 1029 1933
[8] L E Kinsler and W V Houston, Phys Rev, 45, 104 1934
[9] G G Kretschmar Phys Rev 43 417 1933 See also H R Robinson J P Andrews and E J Irons, Proc Roy Soc A 143, 48, 1933
[10] K Shiba Sci. Papers Inst Phys and Chem. Res, Tokyo, 21, 128, 1933
[11] See E T Bell Numerology reviewed in Nature, 133, 80, Jan 20 1934

Reaction Mechanism of Oxidation-Reduction Processes

Certain considerations introduced by Franck and Haber[1], Haber and Willstätter[2] and Haber and Weiss[3] can be developed to give a simple mechanism for oxidation reduction processes in solution, which reproduces in all cases investigated the experimental observations, both qualitatively and quantitatively The relation sometimes observed[4] between reaction velocity and electrochemical potential can also be obtained, so that for the first time a comprehensive theoretical treatment becomes possible

The essential idea is the assumption of electron transfers mainly with ions (in some cases possibly the transfer of H), thus loss or gain of electrons always taking place one electron at a time, whereby radicals are often formed This principle also holds generally for oxidation of more than one step

For example, the mechanism of the oxidation of a bivalent positive (metal) ion (Me) by molecular oxygen would be

$$\mathrm{Me} \quad + \mathrm{O_2} \rightleftarrows \mathrm{Me} \quad + \mathrm{O_2'},\ \mathrm{O_2'} + \mathrm{H} \rightleftarrows \mathrm{HO_2}$$
$$(2\mathrm{HO_2} \rightleftarrows \mathrm{O_2} + \mathrm{H_2O})^3 \qquad (1)$$

$$\mathrm{Me} \quad + \mathrm{HO_2} \rightarrow \mathrm{Me} \quad + \mathrm{HO_2'},\ \mathrm{HO_2} + \mathrm{H} \rightleftarrows \mathrm{H_2O_2} \qquad (2)$$

$$\mathrm{Me} \quad + \mathrm{H_2O_2} \rightarrow \mathrm{Me} \quad + \mathrm{OH'} + \mathrm{OH} \qquad (3)$$

$$\mathrm{Me} \quad + \mathrm{OH} \rightarrow \mathrm{Me} \quad + \mathrm{OH} \qquad (4)$$

HO_2 and OH are the radicals thus produced The amount of hydrogen peroxide appearing as a reaction product is determined essentially by the speed of its further interaction by reaction (3) The autoxidation of certain organic compounds (hydroquinones leuco dyes, SH-compounds, etc), some of which are of biological interest[5], seems to proceed in a very similar manner

Without a metal catalyst, many of these substances are oxidised appreciably only in more or less alkaline media[6], in which the presence of double or at least singly charged anions (R″ or RH) has to be assumed In such cases we need only consider reactions (1) and (2) (H_2O_2 being formed as reaction product) the anion of the organic compound being substituted for Me The formation of the end product then results from the interaction of two radicals

$$2\mathrm{R} \rightleftarrows \mathrm{R''} + \mathrm{R} \text{ or } 2\mathrm{RH} \rightleftarrows \mathrm{RH_2} + \mathrm{R}$$

In seeking a relation between reaction velocity and electromotive force, it is first necessary in all these cases to determine whether reaction (1) is to be treated as an equilibrium practically always existent If this is so, we get the experimentally observed relation[7]

$$E_t = A_1 + K_1 \log t$$

holding (as a first approximation) during the course of the reaction, E_t being the E M F measured at time t, A_1 and K_1 being independent of E_t and t

In comparing the rates of oxidation of different substances, a relation has been established experimentally in certain cases[8] between the times (t_p) for a given percentage change and the normal potentials (E_0) of the oxidised substances This relation is of the form

$$\log t_p = A_2 + K_2 E_0,$$

A_2 and K_2 being independent of t_p and E_0

This relation can also be obtained theoretically if we make the plausible assumption that, for the series of substances for which the relation holds, the velocity coefficients of the electron transfer reaction (2) are all about equal

In more or less acid solutions, many of the above mentioned organic compounds are oxidised only in the presence of metal ions[9] The oxygen then attacks the metal ion directly (reaction 1) producing HO_2' and Me , one of which can then react further as the actual oxidising agent In the case studied by La Mer and Temple[10], the higher valent metal ion (Mn) is evidently the oxidising agent, and thus the relation they obtained between rate and potential can easily be deduced

There are further oxidation reduction processes of the type $R'' + Q \rightarrow R + Q''$ The oxidation of a given R″ by different Q and vice versa has been studied[11] From the mechanism

$$\mathrm{R''} + \mathrm{Q} \rightleftarrows \mathrm{R'} + \mathrm{Q'} \qquad (5)$$
$$\mathrm{R'} + \mathrm{Q'} \rightarrow \mathrm{R} + \mathrm{Q''} \qquad (6)$$

a bimolecular velocity coefficient results, in agreement with experiment[11] If the velocity coefficients for two different oxidising agents Q_a and Q_b, having normal potentials E_a^0 and E_b^0 are k_a and k_b the observed relation

$$\log \frac{k_a}{k_b} = \text{const } (E_a^0 - E_b^0)$$

follows again on the assumption of roughly equal velocity coefficients for reaction (6) in both cases

A full discussion will be published shortly

I wish to thank Sir William Pope for his kind assistance in many respects and Prof F G Donnan for his interest in this work

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March 9

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[1] Franck J and Haber, F *Ber Akad Wiss Berlin* 18, 1931

[2] Haber F and Willstätter R *Ber deut chem. Ges* 64, 2844 1931

[3] Haber F and Weiss J *Proc Roy Soc*, *A* (in the press) See also Haber and Weiss *Naturwiss* 20 948 1932

[4] cf Conant J B *Chem Rev* 3, 1 1927 Michaelis, L and Smythe, C V *J Biol Chem* 94 329, 1932

[5] cf Warburg O *Biochem Z*, 266 1 377, 1933 Kuhn R and Wagner Jauregg, T *Ber deut chem Ges* 67 361 1934

[6] cf La Mer V and Rideal E K *J Amer Chem Soc* 46, 223; 1924

[7] Barron E S G *J Biol Chem* 97 287 1932

[8] cf Barron *loc cit*

[9] cf Reid A *Ber deut chem Ges*, 63 1920, 1930

[10] La Mer, V and Temple T W, *Proc Acad Sci*, 15, 191, 1929

[11] Dimroth O *Z angew Chem* 46 571 1933 See also Conant, *loc cit*

A New Guinea Fish Poison

SOME time ago Dr Hoaslip forwarded to me from Papua a sample of the root of a vine which he stated was used by the natives for two purposes, one, stunning fish from which the root receives its local name of New Guinea Dynamite, the other purpose is suicide

For a time I searched for active poisonous principles in the material, but finally reached the conclusion that the substance was a rotenone containing root its toxicity towards fish is thus accounted for, but its poisonous action on mammals becomes doubtful The root gives a strong colour test in the modified Durham reaction[1] and assays[2] of samples show a rotenone content of from four to five per cent Rotenone extracted from a parcel of the root by carbon tetrachloride, after recrystallisation from amyl acetate had $[\alpha]_D^{21\ 5}$ − 221 9 in benzene (*c*, 5 582) and had m p 164° which was not depressed when admixed with an authentic sample of rotenone.

Dr Wood, of this University, from an examination of the leaves, flower and fruit was of opinion that the plant was a *Derris*, a view which was confirmed by Mr White, the Government botanist of

Queensland A specific determination, however, was not possible on account of the quality of the material, and will have to await the arrival of further specimens this season

The native name for the root varies with locality, but it is known as *tua* or *tuva* on Dobu and Fergusson Islands I am informed that whilst *tuva* is used in some places in the Pacific specifically to denote *Derris elliptica*, in other localities it is used as a collective term for fish poisons in general

Reference is made to the New Guinea *tuva* in general literature[3], and also to the supposedly poisonous properties of the local *Derris* root but in the latter connexion I am inclined to think that the psychical effect of nauseating draughts on the natives cannot be overlooked

A Killen Macbeth

Johnson Laboratories,
University of Adelaide

[1] Jones and Smith, *Ind Eng Chem* (*Anal*) 5 75 1933
[2] Jones *ibid*, 5 23 1933
[3] Fortune Sorcerers of Dobu (Routledge 1932) pp 50 174

Polyspermy and the Endosperm

In preparing an account of the life history of *Acacia Baileyana* I have found strong evidence of polyspermy in connexion with endosperm formation The polar nuclei unfused before fertilisation have one large nucleolus each The sperm which on first contact with the polar nuclei has 13 chromosomes present[1] (presumably telophase) (Fig 1*a*) proceeds to the resting condition, with a small nucleolus (Fig 1*b*) In normal cases this group of two large and one small nucleoli is the most prominent feature of the centre of the sac at this stage Fusion is first between the sperm and one polar nucleus (Fig 1*c*) the product then fusing with the other polar nucleus to form a nucleus with three nucleoli—one small and two large (Fig 1*d*) Some instances were found of divergence from the above normal conditions for example there would be in the centre of the sac one nucleus with one large and one small nucleolus, and another nucleus with one large and two small nucleoli (Fig 2*a*), or there might be altogether four or five small nucleoli (Fig 2*b* *c*), but always at this stage the large nucleoli numbered two The inference from the above is that sometimes there are more than two sperms to be found in the sac There was never any indication that more than one sperm became associated with the egg

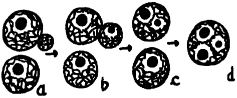

Fig 1 Triple fusion (diagrammatic) (*a*) First contact of sperm with one of the two polar nuclei (*b*) sperm attains the resting condition (*c*) sperm and one polar nucleus fused (*d*) final fusion with second polar nucleus

Ishikawa[2] discussing two cases of the presence of three sperms in the embryo sac of *Œnothera*, and other cases of polyspermy reported by other workers, considers that there are two possible sources of the extra sperm that more than one pollen tube discharges into the sac, or that more than two sperms are produced by the one male gametophyte The former of these two possibilities is favoured in the case of *Acacia Baileyana*, in view of the following facts

In several instances two pollen tubes have been seen projecting from one ovule long after fertilisation, and in at least two cases two pollen tubes were traced across the nucellus to the embryo sac at about the time of fertilisation The pollination unit is a pollinium of sixteen pollen grains There are from ten to twelve ovules (mostly twelve) in the carpel The ovules at the time of fertilisation are naked Without the restriction of a micropyle, and with four surplus pollen tubes it is reasonable to expect that occasionally two pollen tubes would enter an ovule simultaneously Moreover two pollinia have in several instances been found germinating on one stigma, their thirty two pollen tubes providing two tubes for each ovule with a surplus of eight In one case, three pollinia were seen on one stigma, when the forty-eight pollen tubes would provide four tubes for each ovule There is every reason therefore to expect polyspermy Navashin and Finn[3] record in chalazogamous *Juglans* as many as five pollen tubes to one ovule, and three pairs of sperms (one pair having already performed fertilisation) in one sac, with another pair about to be discharged into it !

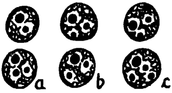

Fig 2 Multiple fusion (diagrammatic) As stage (*c*) in Fig 1 (*a*) Two polar nuclei and three sperms (*b*) two polar nuclei and four sperms (*c*) two polar nuclei and five sperms

Search for the extra sperms in the sac of *A Baileyana* at the time of fertilisation revealed two ovules containing structures that might be so interpreted, and one ovule showing possibly two tube nuclei at a stage after fertilisation was complete

Further evidence should come from chromosome numbers in the endosperm The haploid number is 13 In one endosperm a branched metaphase plate is regarded as showing 91 (7*n*), or 104 (8*n*) chromosomes, according to two possible interpretations of the structures (Fig 3*a*) Only large numbers were seen in the divisions in that endosperm In another endosperm, were one metaphase of 52 (4*n*) chromosomes (Fig 3*b*) and a late prophase and early anaphase estimated to represent 13 (*n*) chromosomes each (in this case one of the sperms or a polar nucleus would have divided without fusion)

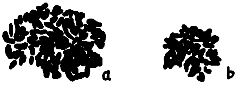

Fig 3 Metaphase plates in endosperm × 1650 Drawn from two different endosperms. (*a*) Branched plate Chromosomes on vertical branch, appearing as 12 pairs of half chromosomes are stippled There are about 91 or 104 chromosomes according as to how other paired structures are interpreted. (*b*) 52 chromosomes

From what literature is available to me here, it seems that even where polyspermy is recorded or discussed, it is only in connexion with fertilisation of the egg But in *Acacia Baileyana* I have seen no suggestion of such an occurrence polyspermy being indicated only in connexion with the endosperm The problem will shortly receive detailed attention as an abundance of suitable material is available here in the Acacias

IVOR VICKERY NEWMAN

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University of Sydney
New South Wales
Feb 16

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[1] Newman I V *Aust and N.Z Assoc Adv Sci* 21 367 1932
[2] Ishikawa M, *Ann Bot* 32 277 1918
[3] Navashin and Finn *Mem Acad Imp Sci St Petersb* 31 1 1913

Chemistry of the Red and Brown Algæ

IN view of the fact that a study of the literature on the red and brown algæ revealed considerable uncertainty as to whether true cellulose occurs in these plants the following seaweeds were examined for cellulose by the usually accepted methods — among the red algæ, *Corallina officinalis Bostrychia scorpioides*, *Chondrus crispus Rhodymenia palmata* among the brown algæ *Laminaria saccharina L digitata*, *Fucus serratus F vesiculosus Ascophyllum nodosum*, *Pelvetia canaliculata* and *P canaliculata* forma *libera*

The crude fibre was obtained by boiling alternately with dilute sulphuric acid and dilute caustic soda, washing the product and testing its solubility in cuprammonia its reaction to iodine and sulphuric acid, and the possibility of obtaining acetyl cellulose By these tests the presence of cellulose was established in every plant examined A full report of this investigation will appear in due course in the *Annals of Botany*

BARBARA RUSSELL WELLS

Botany Dept,
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London, W C 1
March 19

Specific Resistance of the Interior of the Red Blood Corpuscle

MEASUREMENTS of the electric impedance of suspensions of red corpuscles in serum, up to 16×10^6 cycles/sec, give for the specific resistance of the interior of the corpuscle (sheep, rabbit, chicken) 140 (± 10 per cent) ohms at 20° C This value is about twice that of the serum The value is lower than that previously derived[1] from measurements up to $4\ 5 \times 10^4$ cycles/sec, the difference being due to the inaccuracy of the extrapolation from these comparatively low frequencies The low value of the resistance of the interior of the corpuscle as compared with that of the serum is chiefly accounted for by the non conducting bulk of the hæmoglobin

HUGO FRICKE
HOWARD J CURTIS

Walter B James Laboratory for Biophysics,
Biological Laboratory,
Cold Spring Harbor, Long Island, New York
March 22

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[1] H Fricke and S Morse, *J Gen Physiol* 9 153 1925

Thermal Metamorphism around the Ballachulish Granodiorite

FROM recent studies of the metamorphic rocks lying within the aureole of the Ballachulish granodiorite it has appeared that there are present there most of the types of hornfelses listed in Goldschmidt's classification Derived from these are also silica poor types in which corundum and spinel are common Hypersthene has, however not been identified in any of the hornfelses which have been examined up to the present

There is definite evidence that the contact margin of the granodiorite has undergone some contamination by assimilation of the country rocks This is shown by the presence of cordierite in specimens of the granodiorite from the contact It is also noteworthy that hornblende does not appear in these rocks, biotite is alone present and resembles more the red brown haughtonite variety of the metamorphics than the greenish brown variety common to the normal granodiorite Since it appears that the igneous rock has assimilated material from the surrounding schists etc it is probable that the hornfelses have received something in exchange from the granodiorite From a mineralogical examination of the rocks there are indications that, while the granodiorite has become richer in alumina and potash the hornfelses have received lime and magnesia It is proposed to carry out a number of chemical analyses which may definitely establish the details of the suspected interchanges of material

A JEAN HALL

Geology Department,
University
St Andrews
March 15

The Theory of Vision

THE view that the stimulation of the cones of the retina is indirect and takes place through the photochemical decomposition of the visual purple by light seems to be proved and a fact How can the colourless transparent cones be directly stimulated by light? How does this direct stimulation agree with the laws of photochemistry? According to Grotthus s law, no effect can be produced by light unless it is absorbed

F W EDRIDGE GREEN

Board of Trade
S W 1
March 23

Occurrence of the Floating Barnacle in British Waters

ORTON and Rawlinson record, in NATURE of March 17, the occurrence of *Lepas fascicularis* and *L pectinata* on the Cornish coast in the summer of 1933 As they state that the latter has been recorded only about five times in British waters since 1803, it is worthy of record that several specimens were taken on a box found floating off Port Erin I O M, in April 1933

H B MOORE

Marine Station,
Port Erin, I O M
March 23

Research Items

Eskimo Rock-Paintings. Miss Frederica de Laguna in the course of her recent investigations among the Eskimo of Alaska discovered at Cook Inlet in the south west of Alaska a number of rock paintings in rock shelters which she has recently described (*J Soc Américanistes*, Paris, N S , 25, fasc 1) No similar rock paintings are known to occur elsewhere among the Eskimo and they have an individual style which differentiates them from the petroglyphs found among the Eskimo of south east Alaska and among the Indians of the interior of British Columbia The paintings here described are from four shelters of which three are on Kachemak Bay and the fourth in Tuxedni Bay on the western side of Cook Inlet The drawings are in silhouette in red hæmatite mixed with fat Some seem to have been made with the finger or a stick others with a finer instrument Except in one instance (Sadie Cove) there is no effort at composition, nor are all the figures on the same scale Among the subjects represented are men boats with occupants, birds, of which the species can sometimes be distinguished whales (possibly), animals wounded by lances seals and a pregnant woman The object of the paintings does not seem to have been purely artistic as they are never situated near habitations Various explanations were offered by the Eskimo, such as that they were intended to convey information about game and hence they were made on a small scale and well hidden so that the information should not be available for those for whom it was not intended Another explanation connected them with the hunting rites of the sorcerer whale hunters, who use the fat of human victims as poison for their lances On the other hand, it is pointed out that the Indians of British Columbia make rock drawings as a record of initiation rites or of objects seen in their visions

Indian Pearl Oysters Dr Baini Prashad and Mr Jnanendra Lal Bhaduri, after a prolonged study of the true pearl oysters of India, recognise five species, all belonging to the genus *Pinctada* , these are *P margaritifera*, *P vulgaris*, *P chemnitzi*, *P anomioides* and *P atropurpurea* ('The Pearl Oysters of Indian Waters" *Rec Ind Mus* , June 1933) The chief specific characters used are the amount of convexity of the valves, the length and form of the hinge margin, the presence or absence of teeth and the colour of the shells Many of Jameson's varieties are done away with, making the classification considerably simpler There is an enormous amount of variation in each species Most of them have a very wide distribution, shells from different localities, and even from the same area, often varying much in form, outline, thickness of valves and colour In addition to the diagnostic characters of the species, measurements of a number of shells from various localities are given to show the range of variability in shape and sizes

Crabs of the Genus *Parapinnixa* Steve A Glassell in a paper, "Notes on *Parapinnixa affinis* Holmes and its Allies" (*Trans San Diego Soc Nat Hist* , 7, No 27 , 1933), describes *Parapinnixa affinis*, hitherto only known from a single female specimen found by Holmes and one unpublished record of a male and female by Mr G E MacGinitie, from California The present author has collected a series of both males and females at San Diego, California This crab lives as a commensal in the tubes of a marine worm, now being described as a new species of *Amphitrite* This worm builds a slimy tube of mud and sand among clumps of shells and weeds at about mean low tide level in situations protected from the full force of the waves Mr Glassell recognises three species of *Parapinnixa* from the Pacific *P affinis*, *P nitida* and *P yokoyai*, and three species from the Atlantic *P hendersoni*, *P bouvieri* and *P beaufortensis* In a recent paper by Tune Sakai, however, A New Genus and some Species of Crabs from Simoda" (*Sci Rep Tokyo Bunrika Daigaku* (B), 1, No 12 , 1933), a new species from the Pacific is described, *Parapinnixa asiatica*, obtained near Simoda attached to seaweed *Parapinnixa nitida* was found living as a commensal with a terebellid worm *P yokoyai* which is a new name given to the Japanese species called *affinis* by Yokoya is very like the new species from Japan but apparently differs in certain features, notably the shape of the telson The first zoeal stage of *P affinis* hatched from an egg in the laboratory is figured, showing a resemblance to that of *Pinnotheres pisum*

Detection of Tubercle bacilli The *Edinburgh Medical Journal* of March (41, No 3) is a tuberculosis number', and Dr Alfred Emslie records attempts made to detect the tubercle bacillus in the blood stream in cases of pulmonary tuberculosis Contrary to Loewenstein of Vienna, who claims a high percentage of positive results in his cases, Dr Emslie failed to detect the presence of tubercle bacilli in the blood of 34 known tuberculous patients either by cultures or by animal tests This negative result accords with the experience of most observers other than Loewenstein who have sought for tubercle bacilli in the blood of tuberculous patients (see Prof Wilson s critical survey of the literature, Medical Research Council, Special Rep Series, No 182, Tuberculous Bacillæmia ')

Revision of the *Ceratopsia* Prof R S Lull, in a memoir of the Peabody Museum (vol 3, part 3, 1933) has given a revision of that group of the dinosaurs known as the *Ceratopsia* Much work, both in collecting and in investigation, has been done since the earlier account of the group by Hatcher published in 1907, a few years after his death, which dealt with the American species In the present memoir the author brings our knowledge up to date by taking into account not only fresh material found in the United States but also the discovery of *Protoceratops* by the American Museum expedition to Mongolia, a form which throws much light on the earlier evolution of the group Besides the description of the known species and a revision of them, the memoir deals with various other aspects of the family The history of discoveries, the geographical and geological distribution, the morphology of the skull and skeleton, the brain and the evolutionary changes that have taken place during the course of phylogeny are subjects that receive treatment A gradual evolution along several parallel lines has taken place, some of short duration, others longer, and culminating in the various species of the genera *Triceratops* and *Torosaurus* These lines are not all definitely proved and in this the memoir must be considered as an interim report to be corrected at some future date The results so far seem to show a similar evolutionary process to that shown by Osborn to have occurred in the Titanotheres, a principle applicable perhaps to vertebrates generally Works of this kind that bring up to date and summarise our knowledge of various groups of animals are of great use, not only to the specialist but to the general reader as well

Protein Building in Plants A problem which continues to excite interest is that of the methods by which proteins may be built up in plants and particularly, the nature of the raw materials used The passage of years has not seriously affected the view that asparagine may be either a key substance in protein synthesis and degradation or else closely related to the key substance O Loew (*Z angew Bot* 15 518, 1933) now suggests that the process of protein synthesis may start from the reduction of asparagine to the di aldehyde of aspartic acid, $CHO\,CH_2\,CH\,NH_2\,CHO$ He directs attention to the case with which a substance of this type could be further condensed to its lability and to the possible methods by which it could be derived An essential part of the theory is the formation of labile condensation products and microchemical evidence is given as to the existence of materials of the type postulated in certain epidermal cells

Botrytis Disease of Lettuce A very complete account by Dr M M Abdel Salam of the severe disease of lettuce caused by the fungus *Botrytis cinerea* has recently appeared (*J Pom and Hort Sci* March 1934) It is shown that the disease may produce a variety of symptoms—a collar rot (red leg) in spring, lesions on the stem, main veins, or upper leaves (head rot) through the summer, or outright killing if the plant is also attacked by frost in winter The disease is most severe on seedlings over wintered in a cool frame and higher temperatures diminish its effects High humidity favours attack The variety Lee's Immense proved resistant to the fungus, though there was a general tendency to outgrow the damage in spring Steeping the seedlings in 0 5 per cent Uspulun or Nu green solutions for half an hour or an hour gave promising results as a means of control

Sterility in Plants Prof R Ruggles Gates has prepared a concise summary of present-day knowledge of sterility in plants (*J Roy Hort Soc*, 59 141 Feb 1934) Beginning with the methodical observations of Charles Darwin, the author traces the growth of knowledge on plant sterility until recent times Investigations by Prof East provide a reasonable working hypothesis by way of explanation of many problems of sterility Definite sterility factors have been discovered for various species of *Nicotiana*, and fertilisation can only be effected between germ cells having different combinations of these factors This discovery has been put to practical use by Dr A B Stout, working with lilies, Messrs Williams and Slow for red clover and Messrs Crane and Lawrence for cherries Gardens must be planned to include more than one "sterility group" if they are to be productive Recent knowledge seems to confirm Darwin's original observations, for Correns described in 1928 a case of self sterility in *Tolmiea Menziesii* where each plant was self-sterile, but fertile with every other plant of the species

Microseisms in Manila. In a recent paper (*Beit Geoph*, 40, 268, 1933), Father Repetti discusses the microseisms recorded in the Observatory of Manila. To a great extent he finds, they are due to the rhythmical beating of heavy waves on the coast of Luzon, for they appear and disappear with the winds that raise the waves Sometimes, they are clearly connected with passing typhoons Partly, the very conspicuous tremors that are then seen are due to the waves raised by the wind of the approaching typhoon But, when it comes near Manila, the oscillations of the crust produced by the pumping effect at the centre of the typhoon are superposed on those set up by the sea

A New Recording Densitometer The Société Genevoise d Instruments de Physique (address of British agents—5/6, Brettenham House, Wellington Street, W C 2) has issued a description of a new recording densitometer which is said to show a sensible improvement over all other instruments serving the same purpose Its main principle is the usual one of allowing a greatly reduced image (in this instrument so small as to make a primary slit unnecessary) of a glowing filament to travel along the plate to be analysed, the transmitted light, after passing through a slit being received by a potassium photoelectric cell Among the special features of the instrument are a very high speed of automatic recording and a sharp response to small details of the plate, made possible by amplifying the photo electric current so that it can be measured by a sturdy milliammeter of short period instead of an ultra sensitive galvanometer of long period The apparatus can be operated in full daylight and the recordings are absolutely precise, being independent of mechanical parts such as gears or measuring screws Magnifications of 3 4 5 8 10 15 20 and 50 times are obtainable, and the recording is performed at a speed of 15 cm per minute on the diagram The cost of the instrument, which is not given, is said to be considerably below that of similar instruments

Mean Lives of Excited Atoms J H E Griffiths (*Proc Roy Soc* A Feb) has investigated the mean lives of several excited states of the neon atom The atoms are excited in a glass spectrum tube by a high frequency oscillator, and the light is passed through a nitrobenzene Kerr cell between Nicol prisms To make comparative measurements of the decay times of the different spectral lines, the Kerr cell was excited by the oscillator through a phase changing circuit, but since the phase relation between current and voltage in the discharge tube is unknown a different method was employed to determine absolute values The discharge tube and Kerr cell were connected in series and the light path between them was varied by using a movable mirror The number of excited atoms and the intensities of the lines are both periodic, with a frequency twice that of the oscillator From the positions in the maxima of the transmitted light, it was concluded that the lives of the excited states varied from 4×10^{-8} sec to 20×10^{-8} sec The experiments on several lives with a common upper state showed satisfactory agreement With a wide tube it was found that there was an appreciable lag between maximum current and maximum excitation, but this lag was not observed with a narrower tube At the higher pressures the depth of modulation of the light was small with the wider tube, and it seems that electrons disappear from the discharge mainly by diffusion to the walls

Evolution in the Expanding Universe

A LECTURE was delivered by the Abbé G Lemaître, professor of mathematics in the University of Louvain, at Armstrong College, Newcastle upon Tyne, on the subject of "Evolution in the Expanding Universe" before a joint meeting of the Durham University Philosophical Society and the Newcastle Astronomical Society on February 12 Dr R A Sampson, Astronomer Royal for Scotland, occupied the chair, and the speaker was welcomed by Sir William Marris

The age of the universe, calculated from the observed recession of the nebulæ, is about $2{\cdot}4 \times 10^9$ years, whereas the ordinary theory of stellar evolution requires about 10^{13} years If the matter in the universe were evenly distributed, the density would be 10^{-30} gm /cm ^{3} The correction of Newton's law given by Einstein may be regarded as equivalent to a density, of negative sign, associated with space, and if accompanied with a positive pressure the system would be invariant in the Lorentz transformation This density, a cosmical constant, works out at -10^{-27} gm /cm ^{3} and as this is greater than the average density of matter, the effect produced would be, in general, a repulsion

Taking any point as centre, the motion for a nebula at distance r is represented by

$$\left(\frac{dr}{dt}\right)^2 = -h + \frac{2Gm}{r} + \frac{\lambda}{3} c^2 r^2$$

The density of a vacuum is $\rho^0 = \lambda c^2/4\pi G$, where G is the gravitational constant Over large (spherical) areas this is to be regarded as a map in which distances normal to the radius vector are real but those along it are in a scale $\sqrt{1 - h/c^2}$ where h is the energy constant in the equation of motion (h varies as r^2, and m as r^3) For some value $h = c^2$, the scale becomes zero and the map ends, but actually antipodal points are the same, like the points at the sides of a map on Mercator's projection

Suppose now that the universe once consisted of matter with an average density greater than the critical, but with an initial velocity sufficient to carry it over the critical radius, this gives the proper expansion When r is put equal to infinity in the above equation, only the last term is important, so that the velocity squared is equal to $\lambda/3\ c^2$, from which the cosmical constant may be obtained Actually, there must have been fluctuating density in the initial state, and areas in which the separation of matter was less than the mean In these, the matter would eventually fall back producing collapsing regions, more rarely, equilibrium areas would occur which would divide into collapsing regions The first might produce nebulæ, the second, nebular clusters If these areas coalesce, some loss of kinetic energy must take place due to encounters, and the original diffuse matter would agglomerate into stars

A nebula has a mass of about 10^9 suns; its radius at critical density would be 10^5 light years, the order of diameter is now about 1,000 light years The loss of kinetic energy will be

$$\frac{3}{2} G \frac{N^2 m^2}{R}$$

where N is the number of stars, m the average mass of each, R the radius The gravitation energy of a star is

$$\frac{3}{2} G \frac{m^2}{r}$$

where r is the radius Multiplying this by N gives the total and dividing $Nr/R = 6 \times 10^{-2} = 6$ per cent of the gravitation energy of the stars This energy becomes heat, and the heat content of stars is of this order

Regarding clusters, here also the right order is obtained They should have the same densities, and this should be about the critical density If N be the number of nebulæ in the cluster, m the mass of each,

$$Nm = c \times D^3 d^3$$

where D is diameter, and d angular diameter in degrees, and $c = 0{\cdot}155 V^2$ where V is the velocity of recession at 1 megaparsec The observations of Hubble and Shapley give figures of the right order (10^9 suns)

Salmon and Trout Disease

IN the year 1911, cases of a hitherto unrecognised disease, causing death of large numbers of fish of various kinds, were reported from six rivers in the south west of England This was the first official record in Great Britain of the occurrence of furunculosis, a bacterial disease that has spread to many rivers in England and Wales and is now prevalent throughout Scotland Serious outbreaks occurred in the Conway and Coquet districts in 1926 when salmon and migratory trout were attacked, and in the Kennet in 1924 and 1925, when the valuable brown trout fisheries suffered, and in recent years the disease has continued to spread While in 1932 there was a considerable abatement in the number of serious outbreaks in English rivers, in Scotland conditions were nearly as bad as ever

The monetary loss entailed by the spread of this disease must be large, since in one river over a period of six years the estimated loss was £1,400, and in another larger river it was £2,000 in three years But apart from this loss, there must be a more serious loss in the depletion of the breeding stock The alarming increase in the number of outbreaks led to the setting up of a Furunculosis Committee in 1929, a copy of the second interim report of which is now before us * The report indicates the satisfactory progress of research into the problem, carried out by a number of workers chiefly at the Bacteriological Laboratory of the University of Edinburgh, among whom Mrs Isobel Blake deserves special mention

Furunculosis is a disease caused by a bacillus, *B salmonicida*, which infests salmon, trout and coarse fish, in advanced stages of the disease there may be lesions in the muscles, but in many cases death occurs without any obvious external symptoms and the cause can only be definitely proven by bacteriological examination.

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* Second Interim Report of the Furunculosis Committee (Edinburgh and London H M. Stationery Office, 1933) 2s 6d net.

Once established in any locality, the spread of the disease is practically uncontrollable. Experiments have shown that infection can be water-borne or carried in food, and that the presence of fish that have died from the disease may be a serious source of infection. The disease is not brought in from the sea, and migratory fish may be infected in the fresh water sooner or later after they have left the sea; the fish appear to be highly susceptible when they first enter fresh water.

The most dangerous source for the spread of the disease is the occurrence of carriers in which the bacilli are present in small numbers only and are located in the kidneys. Such fish may live apparently unharmed for a considerable time but generally fall victims themselves in the end, not without, however, infecting other members of the community before their death. It has been found that wounds and scratches render fish especially liable to infection.

It is probable that the disease has been spread over so large an area by the practice of stocking rivers with eggs and fry from other localities and from fish farms. It has now been shown that the eggs can be sterilised with dilute solutions of acriflavine.

Experiments and observations in Nature show that the outbreaks of the disease are controlled by temperature conditions, a temperature within a range of about 55°–66° F. apparently being necessary for its spread and development when the fish are healthy; cases have been reported of the occurrence of the disease at lower temperatures among fish in poor condition after spawning. Overcrowding is a further predisposing cause for outbreaks and it is noticeable that where barriers occur to cause the congregation of fish awaiting flood water the disease is prevalent; where possible, therefore, such difficulties in the paths of the fish on their upstream migrations should be removed. The reporting of suspected outbreaks as soon as possible is of the utmost importance, as is also the quick removal of all dead infected fish.

Of even greater importance at this stage is the necessity for the passing of legislation whereby action may be taken to reduce risk of further dissemination to a minimum. In December 1929 an interim report was submitted in which a system of control was urged so that importation of live fish might be controlled and notification of outbreaks of disease made compulsory, and that there might also be power of control both over fish farms and over open rivers declared to be infected. It is to be hoped that the necessity for such action in the near future will receive serious consideration before the plague has assumed such alarming proportions as has been allowed with the musk rat. It is, however, evident that one of the main difficulties in controlling the disease is that the symptoms are not always obvious and that identification necessitates sending the corpses to bacteriological laboratories for examination, and, furthermore, that they should arrive before decomposition has set in.

A New Experimental Phonetics Laboratory

WITH the advent of the talking film, the recording of speech has recently received considerable attention; but, as at the time of the invention of the phonograph, more interest is shown in commercial circles in the entertainment possibilities of the new electrical methods of speech recording and reproduction. In experimental phonetics the older mechanical methods still predominate. At Armstrong College, Newcastle-upon-Tyne, with the support of Prof. W. E. Curtis and Prof. W. L. Renwick, an investigation was undertaken by Mr. R. O. L. Curry, Noble Memorial Scholar, of the available methods of speech recording with the object of seeing how far these were suitable for classifying speech sounds, particularly those of local dialects. The work of making and testing different types of apparatus has been so successful that the Council of the College, mindful of the importance of the investigation, has granted space in a newly acquired building for a phonetics laboratory to house the apparatus, and in which records may be taken under conditions free from noise and vibration.

The laboratory looks out upon an empty court and the windows on this side are sealed and provided with dark blinds. The floor is of concrete and the partition walls are 1 ft. thick, so that it was thought unnecessary to introduce sound-insulating material except on the door, which is faced on the inside with a layer of Newall's Asbestos Blanket. A ventilating shaft in the thickness of the wall leads out to the roof at a point sheltered from street noise. To make doubly sure that no 'ground noise' shall reach the recording apparatus, the microphones are placed in a double-walled insulated kiosk of the telephone cabinet type. There is also provision for the development of photographic plates.

The recording devices which are at present available in the laboratory are as follows:

(1) A kymograph, namely, an instrument in which the pressure variations which occur in the mouth, nose and throat during speech can be severally communicated to membranes provided with styles which make traces on a revolving drum. Owing to the damping and distortion introduced by the recording mechanism this instrument is useless for obtaining exact traces of speech sounds, but is fully satisfactory for recording the relative time intervals involved in speech sounds, and for determining the relative extent to which different parts of the vocal apparatus contribute to the sound, as, for example, in the nasalisation of a vowel or a consonant.

(2) An Einthoven string galvanometer, which, while capable of giving accurate traces of vowel sounds, is too heavily damped with regard to frequencies above 6 000 cycles/sec. to record correctly the fricative high-pitched sounds associated with many of the continuant consonants. This is, in fact, the principle of the apparatus by which most talking films are made.

(3) A cathode ray tube. This is the most effective instrument of all and is capable of delineating the wave form at all frequencies to which the microphones are able to respond. For visual examination of vowel sounds a sweep circuit is used, which allows of a single wave pattern being 'held' on the screen; otherwise a moving film camera is used, capable of taking photographic records of the to-and-fro motion of the spot on the fluorescent screen at 6 ft./sec., a rate which permits of the recording of the high frequency stopping and starting noises that are characteristic of the consonants.

(4) There is also an electric gramophone recorder for making dialect gramophone records, and a jet tone apparatus for studying the action of the vocal organs in speech

The first work of the laboratory, which is under the joint supervision of Mr H Orton, of the English Department, and Dr E G Richardson, of the Physics Department, will be to obtain definitive pictures of the standard English speech sounds This work is, in fact, almost completed Records of dialect speakers will then be taken for the purpose of the main object of the laboratory, which is the comparative philology of the region in which the University of Durham lies In this connexion, room is provided elsewhere in the College for card indexes of local variants in pronunciation

For the benefit of others who may be intending to take up similar work, it may be mentioned that the cost of the equipment of a laboratory such as this is quite moderate Excluding the string galvanometer (which is not essential), the whole of the equipment has cost less than fifty pounds, although it is true that this does not include the cost of the labour of assembling the apparatus

Chemical Society's Mendeléeff Commemoration

THE centenary of the birth of Mendeléeff was commemorated by the Chemical Society on April 19 when Lord Rutherford delivered an address at the Royal Institution on The Periodic Law and its Interpretation"

About the period 1860–70, accurate atomic weights and chemical data were available for the known elements, and the time was ripe for some connecting generalisation The conception of a periodicity in properties when the elements are arranged in the order of their atomic weights was advanced tentatively by Newlands in 1864 Mendeléeff was the first, in 1869, to enunciate the law clearly, to perceive its utility in correlating and even correcting the recorded chemical properties of the elements and to make from it predictions which might be verified by later investigation

Mendeléeff's first table, published in 1871, bears a remarkable resemblance to that of the present day He perceived the true place of the transition elements in the scheme, and did not hesitate to reverse the apparently discordant order of iodine and tellurium Where his table demanded the presence of then unknown elements he ventured to predict their properties, his prophecies being strikingly fulfilled by the subsequent discovery of scandium, gallium and germanium

The discovery of argon and its congeners by Ramsay, at the close of the century, led not to an alteration, but to a widening of Mendeléeff's scheme, the inert gases falling naturally into a group of zero valency and forming a transition between the halogens and the alkali metals During this period, the Periodic Law lacked any theoretical background which might lead to its interpretation Sir J J Thomson's recognition of the electron as a constituent of all atoms of matter, in 1897, first led to the conception of the electrical structure of matter

Lord Rutherford himself has been intimately connected with much of the subsequent development in this field From consideration of the scattering of α particles by heavy atoms, he was led to the nuclear theory of the atom, according to which the mass of the atom is concentrated in a minute, positively charged nucleus, the charge on which is proportional to the atomic weight of the atom The conception that the nuclear charge and ordinal number of an element might be the same was applied by Bohr in his theory of spectra It was brilliantly verified by Moseley's work on the X ray spectra of the elements, which fixed the true order of the elements, and showed that only 92 exist from hydrogen to uranium Of these, only one—No 85—still awaits discovery

The recognition of atomic number rather than atomic weight as defining the properties of the elements cleared away the apparent discrepancies in Mendeléeff's table It has been found that most of the elements are actually complex, consisting of isotopes having the same nuclear charge but different masses The chemical properties of isotopes, depending on nuclear charge, are identical properties depending on mass may differ sufficiently to render separation possible, as is the case with hydrogen and lithium

The explanation of the Periodic Law must lie in the arrangement of the outer electrons Bohr's conception of quantised planetary orbits has been developed by the new wave mechanics to give a complete picture of atomic properties The rare gases have highly symmetrical, tightly bound configurations Addition of successive electrons leads to the occupation of the next group of orbits, and runs parallel to the observed chemical properties of the elements A periodic pattern is thereby obtained, repeating after each inert gas, in which the transition elements and rare earths find a natural place About the structure of atomic nuclei, little is yet known the recognition of any periodicity with increasing nuclear charge awaits the discovery of the future

Increase in Temperature due to Solar Radiation

PROFESSIONAL NOTE No 63 of the Meteorological Office, the title of which is "Maximum Day Temperatures and the Tephigram", by Lieut - Col E Gold, is a discussion of the problem of estimating the probable rise of temperature in the course of a single day during clear weather on account of the solar radiation, with the aid of the 'tephigram' of Sir Napier Shaw

In the 'tephigram' the rectangular co ordinates are temperature and entropy, and any closed area, corresponding with a cycle of changes of a portion of the atmosphere, represents a definite amount of energy Isothermal lines and dry adiabatics are represented respectively by vertical and horizontal lines, and moist adiabatics, corresponding with saturated air that is rising and expanding, and is in consequence having its entropy increased by the energy released by condensation of water vapour, are represented by sloping lines that become more nearly horizontal at low temperatures owing to the diminished capacity of air for water vapour at such temperatures This form of diagram is in use in the

Forecasting Department of the Meteorological Office and the note, apart from the intrinsic interest and importance of the subject should be helpful to forecasters when interpreting the significance of the physical state of the atmosphere revealed by observations made in aeroplanes equipped with meteorological instruments

A discussion of the energy equivalent of 1 cm on this diagram leads up to a consideration of the amounts of radiation received in different months and the heights up to which the dry adiabatic lapse rate can be brought into being in each case, given isothermal conditions initially

When passing on to consider what proportion of the total incoming radiation may actually be available for warming the atmosphere allowance having been made for the increased radiation from the earth s surface the incoming diffuse radiation of short wave length the reflected radiation and for the heat absorbed in evaporating water from the surface the author is on difficult ground An estimation of the last item for example has apparently been based entirely on figures for the evaporation from water tanks the relationship between such figures (practically the only data available) and those representing the average evaporation by day at the season in question from unit area of the earth s surface is very much a matter of speculation The table on p 8 giving the various allowances suggests however that in summer this may be a very important item A suitable warning in regard to the uncertainties of *all* these allowances would not have been out of place in order to prevent the uninitiated from thinking that the difficult problems under discussion have reached anything approaching an exact quantitative solution E V N

University and Educational Intelligence

BIRMINGHAM —The University has decided to institute a Department of Industrial Hygiene and Medicine and arrangements are being made with the view of opening it on October 1 1934 It is believed that this is the first department of this nature to be established in a Medical School in Great Britain The research work contemplated includes the investigation of the deleterious action on work people of the materials they work with and methods of prevention , the training of medical men to advise employers as to methods by which the number of certain types of accidents may be reduced the selection of employees for various kinds of work and improving the hygiene of factories It is probable that the University will grant a diploma to those who complete the course successfully

CAMBRIDGE —The Sheepshanks Exhibition for 1934 has been awarded to C G Pendse of Downing College

The Linacre Lecture will be delivered by Sir Henry Dale, director of the National Institute for Medical Research on Saturday May 5 at 5 p m , in the New Museums The title of the lecture will be Chemical Transmission of the Effects of Nerve Impulses

LONDON —The degree of D Sc in chemistry has been conferred on H E Cox (private study) for ten independent publications and four conjoint subsidiary contributions relating to the chemical examination of furs in relation to dermatitis and food analysis

APPLICATIONS for the Bayliss Starling Memorial Scholarship tenable at University College London W C 1 must be sent to the College Secretary not later than May 12 The annual value of the scholarship is £120 with exemption from tuition fees The scholar will be required to follow a course of study approved by the Jodrell professor of physiology involving a training in the principles and methods of research in physiology or biochemistry or both

Science News a Century Ago

King s College London

On April 30 1834 the annual court of governors and proprietors of King s College was held for receiving the report of the council for the previous year The Archbishop of Canterbury presided The report stated that the council had previously expressed some doubts as to whether it would be possible to complete the river front owing to the considerable sums promised by subscribers not being forthcoming A meeting however had been held at which it was agreed to make an appeal to the friends of the institution and the consequence was that in advances of ten per cent on the shares and in subscriptions and donations a sum of £7 297 17s had been received During the year there had been 104 regular and 171 occasional students in the senior department 66 regular and 175 occasional students in the medical class and 404 students in the junior department A class of associates had been instituted The College had never before been so prosperous Two additional schools had been added so that there were now seven schools in the metropolis acting in union with the College The receipts for the year were £16 197 11s 6d and the expenditure £12 446 14s 5d leaving a balance of £3 750 17s 1d besides £4 000 in exchequer bills

Friday Evening Meetings at the Royal Institution

At the annual meeting of the members of the Royal Institution on May 1 1834 the Visitors commented on the increased membership and improved financial position shown by their Report This satisfactory state of affairs they attributed largely to the interest excited by the Friday evening meetings which had been begun about 1825 and had become a regular feature of the Institution s activities The Visitors reminded members how deeply they were indebted for these advantages to the unwearied exertions important discoveries and happy illustrations of one who has contributed the chief attractions to the meetings in question The reference is to Faraday Not only had he given a considerable number of the discourses himself but from the beginning had acted as secretary of the small committee charged with the duty of arranging the Friday evening discourses That their success depended almost entirely on his activities may be inferred from a letter written to Faraday in 1839 in which W T Brande then the senior professor at the Institution, regretted that he could not help at a time of emergency He wrote You know how sad a figure I cut on those occasions and as to the tact requisite for their general management and arrangement I candidly confess I have it not

Belgrave Literary and Scientific Institution

On Saturday, May 3, 1834, as reported in the *Times*, a public meeting was held to give effect to the arrangements of the provisional committee of the Belgrave Literary and Scientific Institution, and for opening the Institution for the accommodation of members Earl Fitzwilliam presided and the report of the committee said that the foundation of the Society had been laid by voluntary subscriptions of books, and that it was intended to open No 30, Sloane Street for the purposes of the Institution Dr Lardner and others had offered to give lectures gratuitously, the Duke of Sussex had consented to accept the office of patron and Earl Fitzwilliam that of president

A New Orchid

Probably the most important account in *Curtis' Botanical Magazine* for 1834 is that of the first flowering of the new orchid *Epidendrum bicornutum* from Trinidad, which occurred in April 1834 at Wentworth Gardens, the seat of Earl Fitzwilliam, under the care of Mr James Cooper, the celebrated orchid grower The specimen is described (p 3332) as having produced large and highly fragrant blossoms, which smell like the Persian Iris This plant was introduced into England by Mr John Sheppard, curator of the Liverpool Botanic Gardens, marked as "Cattleya n sp" It had many points in common with that genus, especially in its general habit and the large flower, but differed remarkably in the labellum and the shortness of the column The specimen was sent to Prof Lindley who replied to the editor 'Your Trinidad orchideous plant is certainly a new species but I think it can not be separated from Epidendrum The only distinction between it and that Genus consists in the labellum being distinct from the column but you will find various degrees of separation between those parts in *E asperum*, *venosum*, *vitellum* and *bidentatum* which nobody can doubt are genuine Epidendra Should you, however, be of opinion that it nevertheless must form a new Genus, its character will have to depend upon the large size of the petals and the slight adhesion of the sepals to their base The latter is however a falacious character and the former occurs in what I consider true Epidendra"

Other Flower Records

Further interesting records of the flowering of rare orchids and other plants introduced into Great Britain occurred in April 1834, mostly at Kew Gardens In *Curtis' Botanical Magazine* (p 3401, 1835) is described the first flowering at Kew of *Pteostylis acuminata*, the acuminated pteostylis (Orchideæ), of a singular Australian genus introduced by Mr Cunningham from Port Jackson in 1827 *Acacia elongata* (Leguminosæ) a slender and beautiful species from the Blue Mountains of New South Wales and the interior to the west of Port Jackson, originally discovered during the first expedition of Mr Oxley to the Lachlan River in 1817 and introduced into England in 1823, when the plants were received at Kew, was in full flower at the latter gardens in April 1834 Another flowering record of the month, in the gardens of Mr William Christy at Clapham Road, was *Schinus molle*, the Peruvian mastick tree (Terebinthaceæ), which grew wild in Chile, Peru and Mexico The occurrence is recorded, with a plate of the bloom, in the 1834 volume.

Societies and Academies

LONDON

Society of Public Analysts, April 4 GUY BARR and A L THOROGOOD Determination of small quantities of fluorides in water The reagent consists of an aqueous solution of zirconium oxychloride and sodium alizarin monosulphate The test is sensitive for 0 1 part of fluorine for concentrations up to 5 parts per million A W MIDDLETON A test for ethylene glycol and its application in the presence of glycerol The test is based upon the oxidation of glycol to oxalic acid by means of nitric acid, whilst under the same conditions glycerol yields aldehydic substances Glycerol does not interfere unless present to the extent of more than 75 per cent of the mixed alcohols, and the test is sensitive to 0 1 gm of glycol in 10 ml of aqueous solution W MATHER and W J SHANKS Detection of diamines in leather Tests are described whereby extremely small quantities of para and meta diamines can be detected in dyed and finished leathers These diamines can be extracted from leather in the cold by means of $N/10$ hydrochloric acid or 1 per cent acetic acid, and that precipitation of the extracted tannins with lead acetate does not interfere with the subsequent tests for diamines The reagents used include 0 1 per cent solutions of dimethyl *p* phenylene diamine, dimethyl aniline, aniline, *o* toluidine, *p* phenylene diamine, and *m* toluylene diamine

Royal Meteorological Society, April 18 D BRUNT The possibility of condensation by descent of air From a consideration of the variation with height of the humidity mixing ratio, it is shown that in the stratosphere condensation can occur in descending air masses which take up the temperature of their environment The fact that saturated water vapour produces condensation when expanded adiabatically while other saturated vapours produce condensation when compressed adiabatically, is discussed briefly D DEWAR An investigation of the statistical probability of rain in London The paper gives an account of an investigation of the frequency of rain at Kew, based on hourly tabulations of rainfall from 1872 to 1921 Amounts of rain were classified as heavy', 'moderate', slight', or 'no rain', according as the quantity which fell in a 6 hour interval of the day was 1 mm or more, between 0 5 and 1 mm, between 0 2 and 0 5 mm, or less than 0 2 mm The intervals were taken as early morning, forenoon, afternoon and night, each division of the day being taken to cover an interval of 6 hours Each month was divided into three periods of approximately 10 days The probability of rain of a given amount in a given interval of the day during these periods was obtained by dividing the number of occasions on which rain of that amount had fallen by the number of possible occasions A comparison between actual values and figures computed from the average probability shows that the frequency of 'heavy' rain in 6 hour intervals for individual days is distributed approximately according to a chance distribution The average probability of rain in a 6 hour interval is approximately 1 in 9 for heavy rain, approximately 1 in 20 for moderate rain, approximately 1 in 23 for slight rain CALEB MILLS SAVILLE Some rainfall variations, England and New England (U S.A) The maximum and minimum rainfall experienced during periods of from one to twelve consecutive months is similar in both localities Details are given as to the extremes of rainfall recorded at West Hartford (U S A) for periods of 1–120 consecutive months In Great Britain a run of wet years persisted before the present drought but in New England dry years predominated This marked inverse relationship held from 1868 until 1932 in the case of residual mass curves, and from 1838 until 1932 with a somewhat different set of data expressing the rainfall as 5 year means

Paris

Academy of Sciences, March 5 (*C R* , 198, 861–996). Ch Fabry The use of the red cadmium line as a meteorological and spectroscopic standard A discussion of the suggestion of Pérard that the red line of cadmium is unsuitable as a standard, because, under certain conditions, it can be changed into a fine doublet In view of the work already carried out with light of this wave length and of the ease with which this reversal can be avoided, the author disagrees with the view of Pérard Jean Rey The working of a thermocompressor carrying successively two compressible fluids of different densities Experimental results Luc Picart The calculation of the orbits of the visual double stars A Vayssière The internal organisation of the nymphal larvæ of *Bætisca* Gaston Julia was elected a member of the Section of Geometry, in succession to the late P Painlevé Bertrand Gambier Tetrahedra inscribed in a biquadratic and circumscribed to a developable of class 4 genus 1 or to a quadratic R Jacques Certain congruences of spheres Georges Kurepa Directed ensembles Georges Giraud A new generalisation of questions relating to equations of the elliptic type J Geronimus Some extremal properties of polynomials Soula The zeros and poles of a meromorph function in a sector P Vincensini The centres of gravity of homogeneous finite bodies J Ottenheimer The displacement of water in the course of submarine explosions J Dupuy The application of interference to the study of the distribution of the pressures and velocities round the wing of an aeroplane Edmond Brun The heating by friction of a body undergoing rapid displacement in carbon dioxide Henri Roure An inequality with very long period of the mean motion of Pluto due to the action of Uranus A Dauvillier The nature of the photosphere and of the electronic emission of the sun P Salet The measurement of the velocity of the light coming from the stars From an analysis of the experimental data available, the author concludes that the spectroscopic method gives different values for the velocity of light according to the spectral type P Lejay and Lou Jou Ye Observations of the intensity of gravity in the north-east of China The results of measurements with the Holweck Lejay instrument for 37 stations are tabulated Bernard Kwal Spinors and quaternions L Dunoyer The measurement of small expansions Suggested modification of the Chevenard interference dilatometer P Donzelot, E Pierret and J Divoux Indirectly heated valves in the amplification of continuous currents V Posejpal The materialisation of the polarised ether F Bourion and Mlle D Beau The magnetic study of hydrated thoria, Hydrated thoria behaves from the point of view of its magnetic properties as a mixture of water and a feebly paramagnetic hypothetical oxide, ThO$_2$ P Lainé : The magnetic properties of mixtures of liquid ozone and oxygen The magnetic susceptibility of pure liquid ozone The specific susceptibility of liquid ozone, at temperatures near that of liquid air, is about 1 5 × 10^{-7}, with a thermal variation certainly less than one third of that which would be predicted from Curie's law Albert Perrier and Mlle T Kousmine Longitudinal magneto thermoelectric effects in nickel and iron theoretical interpretations. P Debye, H Sack and F Coulon Experiments on the diffraction of light by ultra-sonic vibrations F Wolfers The diffraction phenomena of Fresnel with a large source [of light] Picon Some solubilities of quinine iodobismuthate The behaviour of the quinine salt with acetone, cyclohexanone and ethylene glycol is described Pariselle Polarimetric researches on narcotine Narcotine, lævorotatory in organic or neutral media, is dextrorotatory in acid or basic solution Mlle Sabine Filitti : The oxido reduction potential of the system xanthine $\rightleftarrows$ uric acid Victor Lombard and Charles Eichner An attempt at the fractionation of hydrogen by diffusion through palladium Hydrogen which has been diffused through palladium diffuses at a different rate from the non diffused hydrogen The authors are not inclined to ascribe this difference to the accumulation of impurities, but consider that the fractions probably contain different proportions of allotropic varieties of hydrogen Édouard Rencker Study of the softening point of vitreous bodies by differential thermal analysis Marcel Chaussain and Henri Fournier The chemical methods of cleaning light and ultra light metals after corrosion The use of nitric acid for removing the products of corrosion of the light metals, requires a correction for the clean metal dissolved A suitable method of obtaining this correction is indicated

(*To be continued*)

Geneva

Society of Physics and Natural History, December 21 P Rossier The spectrographic photometry of the F_0 stars On the basis of 120 spectrograms the author states and discusses the relation between the magnitude and the length of a spectrogram This relation, which is linear, depends on the spectral type F Batelli, D Zimmet and P Gazel The epicephalic reflex in amphibians

Cracow

Polish Academy of Science and Letters, December 4 K Dziewonski and T Duzyk The action of chloracetyl chloride on β naphthol P Lada Contributions to the genetics of fragile rye J Wlodek, Mme M Wodzicka and E Ralski Granitic soils covered with plants requiring lime (Morskie Oko, Haut Tatra, Poland) K Gajl *Branchinecta paludosa* from the Tatra massif considered as a new species Remarks on the morphology, ecology and zoogeographical distribution of this species Zdz Raabe Certain species of the genus *Conchophthirus*. M Gieysztor : The group of species *Dalyellia viridis* (Rhabdocœla) F Bieda The nomenclature and classification of certain species of Nummulina (2) Z Grodzinski The development and comparative anatomy of the axial blood vessels in the anterior extremities of vertebrates J Zacwilichowski The innervation and the sensorial organs of the wings of the Trichoptera B. Skarzynski Œstrogenic substances of plant origin. W. Heinrich The reaction of the capillary vessels of the rabbit during the working of the cortical centres.

January 8 S Mazurkiewicz Translative means and the law of Gauss H Gams The Starunia mosses considered as an index of the character of the flora and climate as well as the principal petrifactions of the diluvial epoch J Stach The genus *Onocopodura* and also a new species belonging to this genus found in the caves of north east Italy T Vetulani and R Schuler The hypophysis of the small Polish horse representing the type of the tarpan horse (1 and 2)

LENINGRAD

Academy of Sciences (*C.R* No 3 1934) V Fock New asymptotic expression for Bessel s functions N Koshliakov On a certain definite integral connected with the cylindric function $K_\nu(x)$ I Verchenko and I Kholmogorov Discontinuities in the functions of two variables A Kapustinskij The problem of the composition of air in the stratosphere Samples of air brought from the stratosphere by Prokofiev proved to be almost identical with the air near the ground This can be explained by the enrichment of the stratosphere by nitrogen owing to gravitation (Laplace s rule) and by oxygen through thermal diffusion as described by Dootson Chapman and Endskog G Kwater, N Kremenewsky and A Filippov The absorption spectrum of thallium vapour in the ultra violet M Savostianova The problem of the excitation of an alkali haloid crystal A Chichibabin and M Oparina The volatile base of Valerian roots The base is a colourless oil which does not crystallise at 0° C and is insoluble in water I N Nazarov On metal ketyls of the aliphatic series (2) It is only secondary and tertiary radicals connected with a carbonyl group that make possible the existence of metal ketyls The stability of metal ketyls is particularly increased by the tertiary heptyl $(C_2H_5)_3C$ K Gorbunova and A Vahramian The mechanical activation of the surface of an electrode The formation of the first microcrystals occurs at a lower potential when the surface of the electrode bears scratches than when it is intact A Charit and I Fedorov The oxidation and reduction processes during muscular contraction (2) The oxidation reduction potential of blood and of urine under the influence of muscular work The potential of arterial blood before work was 0 607 v and after work 0 578 v figures for the venous blood were 0 580 v and 0 557 v and for urine 0 118 v and −0 73 v respectively D Sabinin (1) Exchange adsorption in root systems Adsorption processes play an important part in the entrance of substances into cells if the substances are derived from diluted solutions with varying values of *p*H and in the presence of surface active substances (2) Influence of the technique and time of the introduction of fertilisers on the nature of plants M Shkolnik The physiological rôle of boron The absorption by plants of phosphate nitrate and calcium decreases in the presence of boron which therefore exercises an influence on the permeability of the protoplasm V Civinskij Capacity of cotton to withstand cold Those varieties in which the concentration of the cellular sap was high proved to be most resistant to frost but some other factors may also be of importance B B Rohdendorf Some new species of Tachinids from U S S R Two new species of *Craspedothrix* (Diptera, Larvaevoridae) O Vialov and R Vialova The age of the tufogenous suite of Caucasian flysh The fossils indicate that the suite belongs to the Cenomanian

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, April 30

UNIVERSITY COLLEGE LONDON at 5 —Prof C Singer and K J Franklin 'The History of Physiology (succeeding lectures on May 1 2 7 8 14 15 and 22) *

ROYAL GEOGRAPHICAL SOCIETY at 8 30 —F Kingdon Ward The Himalaya East of the Tsangpo Gorge

Wednesday, May 2

ROYAL SOCIETY OF ARTS at 8 —J C Wilson Trichromatic Reproduction in Television

Thursday May 3

KING S COLLEGE STRAND W C 2 at 5 —Prof R J S McDowall 'The Integration of the Circulation (succeeding lectures on May 10 17 and 24) *

INSTITUTION OF ELECTRICAL ENGINEERS at 6 —Dr M Schleicher Modern Practice in Germany and other Parts of the European Continent with regard to Supervisory Control Systems as applied to Large Interconnected Supply Areas

CHEMICAL SOCIETY at 8 —Discussion on Unicellular Chemistry to be opened by Dr J Vargas Eyre

Friday May 4

PHYSICAL SOCIETY at 5 —Prof C V Boys My Recent Progress in Gas Calorimetry (Nineteenth Guthrie Lecture)

HUXLEY MEMORIAL LECTURE at 5 30 —(in the Lecture Theatre Huxley Building Exhibition Road, South Kensington S W 7) —Prof Johan Hjort The Restrictive Law of Population

INSTITUTION OF MECHANICAL ENGINEERS at 7 —R C Walker Photoelectric Cells and their Application (Informal meeting)

GEOLOGISTS ASSOCIATION at 7 30 —(in the Architectural Theatre University College Gower Street W C 1) —L A Wager Mount Everest and the Eastern Himalaya

WORLD S DAIRY CONGRESS April 30–May 6 —To be held at Rome and Milan

Official Publications Received

GREAT BRITAIN AND IRELAND

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1562 (I C E 887 T V C 59) Torsiograph Investigations on a Radial Engine with and without a Spring Hub, with some reference to Damping By B C Carter N S Muir and H Constant. Pp 14+19 plates (London H.M Stationery Office) 1s 6d. net.

OTHER COUNTRIES

Obras completas y Correspondencia científica de Florentino Ameghino Vol 12 Primera Sinopsis Geológicopaleontológica Dirigida por Alfredo J Torcelli. Pp 770 (La Plata Gobierno de la Provincia de Buenos Aires)

Kungl. Svenska Vetenskapsakademiens Handlingar Serien 3, Band 13 No. 2 Untersuchungen über Dunkelnebel Von Carl Schalén. Pp 47 (Stockholm Almqvist and Wiksells Boktryckeri A B)

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 21 No 13 The Templeton Crocker Expedition of the California Academy of Sciences, 1932 No 13 Diptera. By C. H Curran. Pp 147–172 (San Francisco)

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1933. (Publication 3235) Pp iv+59 (Washington D C Smithsonian Institution.)

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Rewards for Scientific Discoveries

THE continued growth of nationalism during the past few years has brought clearly to the mind of many people the thought that *pace* the League of Nations and all it represents the struggle among nations will in the future as so often in the past result in the battle going to the strong and the race to the swift One consequence is that the governments of the more important nations aware of the futility of trusting to mere numbers of man power are turning more and more to the encouragement of the best minds among their own nationals in the hope that their discoveries will place their own nation in the forefront and so enable it to reap the due reward be it either in war or in peace

Although this encouragement has taken various forms in different countries and includes in most countries the granting of honours and the general esteem of the public in no country has it taken a form which is regarded as entirely satisfactory while in most countries the reward whether to workers in science or in art must be regarded as deplorably inadequate from the financial point of view In Great Britain the difficulties of the Department of Scientific and Industrial Research in the realm of science are only too apparent while the inadequacy of the reward of composers in view of the vast development of broadcasting and the gramophone is a matter for keen regret In other countries similar problems are forming the subject of most searching inquiry an example of such inquiry being the first of a series of papers which the Council of the American Association for the Advancement of Science is authorising the paper being the Report of the Committee on Patents Copyrights and Trade Marks entitled The Protection by Patents of Scientific Discoveries published as a Supplement to *Science* in January last (New York The Science Press) Extracts from the Report appear elsewhere in the present issue of NATURE

Much discussion has occurred upon the question of the patenting of scientific discoveries In an attempt to formulate a policy or agreement upon principles it may be worth while to consider first those inventions which have possible industrial uses and are patentable and whether scientific investigators should obtain patents on such inventions which have resulted from their work medical patents being for the moment excluded as presenting peculiar difficulties Many objections have at various times been raised against patenting by scientific investigators, among them, for example, being that it is unethical for scientific men or professors in universities to patent the results of their work, that publication or dedication to the public is sufficient to give the public the work of a scientific man, that patenting will lead to the debasement of research, that patents will place unfortunate strictures on other men who afterwards do fundamentally important work in the same field, and so on

After considering these and other objections, the opinion of the Committee is that the patenting of the results of research (other than medical research) which have some possible commercial importance or industrial application is highly desirable, and indeed it is difficult to understand how any opposite opinion could be held either in the United States or elsewhere

The question of medical patents is in Great Britain admittedly difficult, mainly because the preponderating weight of medical opinion is against the granting of medical patents to medical practitioners At the annual general meeting of the British Medical Association in July 1931 there was a prolonged debate which resulted in a resolution

> "That the Association approves the traditional usage in accordance with which it is unethical for any medical practitioner who discovers or invents any substance, process apparatus, or principle likely to be of value in the treatment of patients to act against the public interest by unduly restricting the use and knowledge of such discovery or invention for his own personal advantage"

It should be remembered, however, that although medical opinion in Great Britain is opposed to the patenting of medical inventions by medical practitioners, the recently revised patent law (see the Patents and Designs Acts 1907–1932, Section 38 A) permits the patenting of medical inventions by any person under rigidly defined conditions which adequately protect the public interest Whether in these circumstances it is either in the best interests of the medical profession or in the public interest that medical practitioners should hold aloof from patenting medical inventions, may reasonably, it is submitted, be open to doubt

Probably most of the discoveries made by scientific investigators cannot be protected under our present patent laws even if the investigators so desire, and there remains, therefore, the question whether the present inadequate reward of investigators in fields outside patentable inventions can be increased by any means alternative to those at present employed, for not even the most exalted scientific man can subsist solely on honours and public esteem

The brief history of alternative means which have been suggested is that before the War vague proposals were, from time to time, put forward for the protection of scientific property, that is, the property which a scientific investigator might reasonably be held to have in the whole of the results attributable to his work After the War, however, definite proposals were made and soon became an issue with the League of Nations, resulting in the adoption in 1922 by the International Committee of Intellectual Co operation of the following motion

> "The Committee, considering that intellectual property is not sufficiently protected and that scientific property particularly is at present not protected at all, entrusts a subcommittee consisting of MM Destree, Millikan Ruffini and de Torres Quevedo with the duty of examining the means by which this protection may be assured"

Western European nations weighed and pondered the issue France, Italy, Norway, Switzerland, Spain and Portugal announced in favour of the protection, while Great Britain, Austria and Germany opposed it In the United States, almost dead silence was maintained, "due probably and mainly to an ignorance of the question" (R Spencer, "Scientific Property", *American Bar Association Journal*, February 1932)

Different plans were proposed for affording protection (1) by the establishment of an international bureau, (2) by the creation of a fund contributed to by manufacturers, (3) by donation of government funds to the discoverer and (4) by the extension of the patent system to include scientific discoveries

The conclusion of the whole matter from the American point of view seems to be that no practicable and desirable means alternative to those in operation at present has been proposed It is probably the fact that in Great Britain a similar opinion is held So far as inventions form subject matter for the grant of Letters Patent, the law has been recently revised and brought up-to date in the Patents and Designs Act of 1932 Any person, be he scientific investigator, medical practitioner or otherwise is at liberty, unless as in the case of the medical practitioner he is restrained by ethical or similar considerations, to apply for the grant of a patent for any invention which constitutes a new manner of manufacture If the invention or discovery lies outside the field covered by the Patents Acts, no alternative to the present means which is practicable and desirable has been suggested, and if scientific investigators in this field are to be adequately rewarded, it seems that the only way open is for a more generous support to be accorded to them both by public and private benevolence than has hitherto been the case

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Myths of Polynesia

Religious and Cosmic Beliefs of Central Polynesia
By Robert W Williamson Vol 1 Pp xxi+399 Vol 2 Pp vi+398 (Cambridge At the University Press, 1933) 50s net

A REVIEW of these two volumes must be the funeral oration not only of a good worker, but also of a school the best traditions of which he worthily represented Of this school Tylor may be considered the father He proceeded by culling illustrations from the whole world and in making generalisations without any strict method It was the only course open to those pioneers to whom only fragments were as a rule available They were like surveyors on the top of a mountain picking out the salient features of the landscape, indicating roughly the trace, and leaving it to others to work it out in detail

In this second line of survey, Mr Williamson holds an honourable place As a rule such systematisers lack the vision of pioneers Mr Williamson is no exception Nor has he the gift of style to help us over the crowded shingle of facts To take a specimen at random "Tyerman and Bennet say that Orion was known by name According to J R Foster the stars forming his Belt were called E whettoo mahoo Moerenhout says the stars of the constellation were called Fehone tarava, and guided their navigators at night The London missionaries say " (vol 1, p 125), but even the expert wants a pause in the midst of these enumerations

Lack of imagination leaves the treatment rather mechanical The geographical boundary is drawn by latitude and longitude rather than by a point of view By restricting himself to Central Polynesia (except for a few temptations to glance at islands just out of bounds) the author makes difficulties for himself Thus he is puzzled by the fact that in the Paumotuan myth of the separation of sky and earth the sky is female, not male as we have been brought up to expect This he has to explain as "an accidental mistake" (vol 1, p 28) Had he allowed himself a peep at Egypt he would have found the same myth with the sky as female What seems a mistake is really an important piece of evidence it proves there are two versions of the myth occurring side by side from the Near East to Polynesia But it is an axiom with this school that nothing ever travelled before our own culture except within restricted areas, such as Polynesia Any interchange of ideas outside those areas as between Polynesia and India, or Polynesia and America, is rigorously taboo

Equally mechanical is the classification, for example, into creation, sun, moon, stars, winds, and so on It is not with natural phenomena we are concerned, but with the minds that think about these phenomena, and there is not one department of the mind that deals with creation, another with the sun, another with the moon All these different phenomena may figure in the same system of thought, such as the creation cycle, which is one big system including myth and ritual of sun, moon, stars and many other things, on the other hand, the sun may figure in different systems, as in our creation myth and in our astronomy, two systems which some people manage to keep completely apart in their minds

For purposes of reference however, nothing can be more suitable than a mechanical classification such as the author adopts After all, no one has discovered a better arrangement of words in a dictionary than the purely mechanical one of following the alphabetical order It is as a work of reference that Mr Williamson's book has to be judged For new and fruitful points of view we shall look in vain The conclusions boil down to waves of migrations which are neither proved, nor worth proving, a mere variation on that most unfortunate theme, vol 2 of The History of Melanesian Society" It is sad that Rivers at his best should find no imitators, while Rivers at his worst is still taken seriously

The author could have laid the fault at the door of his authorities, but, like a good workman, he does not blame his tools Yet he might have done so with justice The literature on Polynesia is too much made up of scraps for the most part to give us a picture of any single culture as a whole It is only recently that we have come to realise that all these scraps are parts of recurrent patterns, and that it is those patterns that really matter (see, for example, 'Myth and Ritual , ed S H Hooke, Oxford, 1933) Mr Williamson could scarcely be expected to bring out those patterns since they are not in the materials he had at his disposal All he could do was to rescue for the student all those fragments which lie scattered in endless volumes, and leave the student to infer from the fragments the presence of patterns known elsewhere in their entirety That work Mr Williamson has done right well

As work of reference these volumes deserve nothing but praise The Tylorian school shines in such tasks With its best qualities the author is liberally endued It is easy to see the weak points of a school that is passing away, but when it has been dead for the lapse of a generation men begin to regret its virtues Mr Williamson almost makes one regret them before it has completely passed away, for in these days of competition for renown it is not common to find an equal degree of thoroughness, absolute honesty, self dedication to a laborious task, absence of demagogic arts, as we find in these pages The result is a complete and reliable survey of Polynesian mythology indexed in a manner which it is no exaggeration to describe as ideal The work will never have to be done again, because Mr Williamson has left nothing more to do

A M HOCART

Medical Genetics

The Chances of Morbid Inheritance Edited by Dr C P Blacker Pp xi+449+7 plates (London H K Lewis and Co, Ltd 1934) 15s net

THIS book, which is edited by the secretary of the Eugenics Society, sets out to help the practitioner to answer three questions which, as the editor states in his admirable preface, are often asked Ought I to get married ?" If I get married, ought I to have children ?" 'If I get married and have children, what are the chances of their inheriting my disease, or a disease which occurs in my family ?" Clearly only the third question can receive a scientific answer Many believers in negative eugenics will question the advice given elsewhere in the book that sufferers from certain diseases should be sterilised before marriage Such a course, among other things, virtually sterilises a healthy spouse Nor will the political views which are expressed by certain contributors meet with universal acceptance

The articles in the book are of very unequal value Some, such as Dr Campbell's on cardio vascular diseases, are not only excellent summaries of existing knowledge, but also contain new contributions to it The majority appear to be written in ignorance of certain essential facts disclosed by research on animals The most important of these is that genes causing abnormality often (probably in the majority of cases) do not manifest themselves in all individuals carrying them Thus Timofeeff Ressovsky found that in one genetically homogeneous line of *Drosophila funebris* carrying a certain pair of genes a particular abnormality showed in all members, while in another line it manifested itself in only 53 per cent of females and 80 per cent of males In certain crosses the gene which was generally nearly recessive, behaved as a dominant in about 5 per cent of heterozygotes This at once disposes of the statement in the chapter on 'Genetic Principles" that "if a condition appears several times from normal parents, then the conclusion that it is recessive is a safe one", and it renders unnecessary the hypothesis quoted by various authors (for example pp 48, 60, 421) as to the implication of several pairs of genes in certain family histories

Other authors appear to have overlooked much of the existing literature Thus the section on hereditary diseases of the eye contains no reference to Waardenburg's book on this subject, which is certainly the most complete in existence or to the Nettleship memorial volume of the 'Treasury of Human Inheritance" Still more unfortunate is the lack of reference to Cockayne's "Inherited Abnormalities of the Skin' The author of the chapter on skin diseases quotes three family histories of epiloia, and suggests that the condition is recessive Cockayne, after an analysis of twenty five families, comes to the opposite conclusion It is twice stated that infantile amaurotic idiocy is confined to Jews Slome listed eighteen cases in non-Jews

The article on skeletal defects is mainly concerned with embryology rather than genetics It devotes two pages to congenital club-foot in mice without mentioning Bonnevie's remarkable discovery that it is caused by the escape of fluid from a foramen in the embryonic myelencephalon which upsets the development of the limb rudiments No mention is made of such well known hereditary defects as osteopsathyrosis and multiple exostoses

If Mendelian studies are misinterpreted, the biometricians fare still worse Thus we read (p 396) that "Karl Pearson found in his series that tuberculous infection in a family tree bore vaguely the same ratio as the inheritance of other more easily recognizable characteristics' I take this to mean that the coefficient of correlation between parent and offspring for tuberculosis fell within the limits found for characters which are clearly inherited

When all criticisms are made, those chapters whose authors, instead of writing essays on heredity and environment devoted themselves to giving facts on which a prognosis can be based, are a valuable collection of data, enormously superior to that of Baur, Fischer, and Lenz, the only comparable work in English If a second edition is called for, we may hope that some of the mistakes will be corrected and the deficiencies made up, in which case the value of the book would be very greatly increased The index is imperfect

From the point of view of eugenics, serious inherited abnormalities may be classed as follows

(1) Dominants and sex linked recessives with approximately 100 per cent manifestation, for example, hæmophilia and blue sclerotics Here affected persons, or women who are certainly carriers, should not have children, but normal relatives can do so with comparative safety

(2) Dominants with incomplete manifestation, for example, cleft palate Here, unfortunately, unaffected persons may transmit the disease, and it is important to find means of detecting the gene where it is not clearly manifested, as Campbell and Warner did (pp 224, 272) in acholuric jaundice

(3) Autosomal recessives Here parents who have produced one abnormal child should produce no more, but it is not obvious that heterozygotes should abstain from marrying unrelated persons, as suggested on p 36 About 0 5 per cent of the population of Sweden carry a recessive gene for amaurotic idiocy, and probably few of us are devoid of undesirable recessive genes It is doubtful whether the knowledge that one such is carried should deter a healthy person from parenthood

(4) Conditions which may be due to several genes Here a family analysis is necessary But the chance of transmitting to the children a character which is not found in any of the parents or grandparents is usually small

A classification on these lines would not be difficult, and would greatly enhance the value of the book to practising physicians J B S H

Applications of Fluorescence Analysis

Fluorescence Analysis in Ultra-violet Light By J A Radley and Dr Julius Grant (Monographs on Applied Chemistry, Vol 7) Pp xi+219+14 plates (London Chapman and Hall, Ltd, 1933) 15s net

THIS book is designed to fill a gap in our technical literature, which up to now has yawned both deep and wide It is written by chemists for their *confrères*, but while the analyst and works chemist will appreciate every chapter, there are many others to whom it will prove valuable for guidance in empirical testing of their own special materials This will be so in the examination of textiles, minerals and gems, paints and varnishes, paper and various cellulose derivatives, museum specimens various foreign postage stamps and numerous other objects which are dealt with in nineteen classes, to each of which a separate chapter is devoted

Each section closes with a more or less extensive list of bibliographical references, which, the authors claim, amount in the aggregate to nearly 800 Each is numbered, and each number finds a place in the text where some indication of the contents of the paper is given, and all this is of permanent value Unfortunately, however, some of these undoubtedly enlightening passages are blurred by the statement being so confused as to leave the reader no alternative to resorting to the originals for instruction For example

> '*Glasses which Transmit Ultra-Violet Light* —W E S Turner and D Starkie[9] examined a number of commercial glasses covering the ranges 7000 to 2000 A and 2950 to 3150 A (which, how ever, is usually of therapeutic interest), and the following percentage transmissions were observed —Corex, 89 Sanalux, 73 Sun Ray, 62 Holvi, 61 Vita, 54 Helio, 52 Uviol, 46 Quartz Lite, 4
>
> Ordinary window glass[35] is taken as unity After use the various glasses showed a decrease in power of transmission varying from 13 per cent for Vita glass to 7 per cent for Sanalux" (p 23)
>
> '35" refers to a paper by H Valentin

The first 55 pages are devoted to "Theory and Technique of Fluorescence Analysis", which is arranged in five chapters dealing with theory, production of ultra-violet light, filters, measurement of intensity, and methods of examination Unfortunately, here also a similar laxity of expression prevails, thus on p 3

"(2) *The Ultra-Violet Region*, with which we are mainly concerned This is divided into the 'near' and 'far' ultra violet and extends from about 136 to 4000 A , the rays of the near ultra violet have the longest wave lengths and overlap with the violet rays of

(3) *The Solar or Visible Region*, the extreme wave length limits of which are about 0 0003 mm (near ultra violet) and 0 007 mm (infra red) This region constitutes what we call 'white light', which, of course, is the resultant effect on the eye of the colours of the visible spectrum '

and lower down on the same page

"*The Ultra Violet Region* —The position of this region is interesting It falls between the shortest rays visible to the human eye and the X ray region of longest wave length, about which little is known Generally speaking, therefore, ultra violet rays may be considered as intermediate in properties, such as penetration, between X rays and solar rays "

On p 2 we are told "the shorter the wave length the longer is the frequency"

A few typographical inconsistencies occur 0 007 for 0 0007 (p 3), A F Kitchen (p 93) and A F Kitchin (p 215) for A F Kitching T Brewis (plate No 2) for E T Brewis

The book is so useful in its scope that one must hope that a second edition will be called for, and so provide the authors with opportunity for improving the text, and at the same time rendering some of the more important sections a little more comprehensive

The book is uniform in style with others in the series edited by Dr E H Tripp, and is very well produced, especially the ten pages of luminograms on art paper at the end S JUDD LEWIS

History of Geography

(1) *A History of Exploration from the Earliest Times to the Present Day* By Brig General Sir Percy Sykes Pp xiv +374+25 plates (London George Routledge and Sons, Ltd , 1934) 25s net

(2) *The Making of Geography* By R E Dickinson and O J R Howarth Pp vi+264+5 plates (Oxford Clarendon Press , London Oxford University Press, 1933) 8s 6d net

EXPLORATION has provided the material out of which a science of geography has been created The gradual expansion of man's knowledge of the earth, obtained by voyages of discovery and journeys of travel, has been followed at every stage by a development of geography as a scientific subject The workers in the study and the map-room have slowly absorbed the results of exploration into the common stock of knowledge and welded them into a system It is therefore possible to write a history of two parallel developments on one hand, the history of exploration, and on the other, the history of geographical thought and ideas As the two subjects are closely related to one another, it is appropriate that two books dealing with these distinct aspects of geography should be discussed together

(1) Sir Percy Sykes is himself an explorer and he has been able to enrich his 'History of Exploration by personal knowledge of many of the regions described He followed in the track of Alexander the Great in 1894 He identified many sites in Persia that are mentioned by Arabian geographers He states that his chief ambition was 'to tread the Pamirs in the footstepp of Marco Polo and to shoot an *Ovis Poli* and on no expedition that I have made does the golden haze of reminiscence lie more brightly than that on which I successfully stalked these mighty rams in the remote upland valleys of the Roof of the World

As might be expected, the author pays special attention to the exploration of Asia, the continent in which most of his own journeys have been made, and includes an unusually detailed study of the unveiling of Arabia By comparison with his treatment of Asia, the author's accounts of the exploration of the Americas and of Australia are rather summary in character The book is well illustrated and includes a series of 36 maps, but it should be noted that 25 of these are reproduced directly from Mr J N L Baker's History of Geographical Discovery and Exploration" Sir Percy Sykes's book will not replace Mr Baker's standard work, but it should have a wide popular appeal and will serve as a useful introduction to the vast subject with which it deals

(2) Within the narrow compass of two hundred and sixty pages, Mr R E Dickinson and Dr O J R Howarth have endeavoured to describe the history of the development of geography as a subject, and they have been severely hampered by the limitations of space Dr Howarth has written the earlier chapters which deal with the history of geography before the great age of discovery , and this is probably the most satisfactory part of the book, although the achievements of medieval geographers are not fully appreciated

The task of writing the history of geography from the year 1500 up to the present day is a heavy one and perhaps the time is not yet ripe to make such a general survey Work such as that contained in Prof E G R Taylor's recent volumes on Tudor and early Stuart geography are the necessary preliminary before the history of geography as a whole can be written It is certainly too early to assess the place of contemporary British geographers in the development of the science, as is attempted in this book Mr Dickinson does not appreciate the relative importance of the geographers of the seventeenth century, and devotes a disproportionate amount of his space to some of the minor figures He barely mentions the great achievements of James Rennell who was justly described by the late Sir Clements Markham as the greatest geographer that Great Britain has yet produced The map which is supposed to show the progress of exploration is inexcusably inaccurate Mr Dickinson says that the goal of geography is the region and writes at some length on the development of the regional concept" in the nineteenth and twentieth centuries It will not be easy for regional geography to develop if, as Mr Dickinson suggests, much of the peripheral field of geography is to be abandoned to persons called "specialists in the other camp" (p 250) The reason that regional geography is so difficult and is so seldom successful is surely that it cannot be written without mastering the disciplines of several other camps

The second half of the book contains an unusually large number of errors in the spelling of names and similar mistakes The bibliography provided for the first half is very incomplete, and while the references are fuller in the later chapters of the book, many of them are difficult to verify The volume as a whole is not an improvement on the far less ambitious ' History of Geography" previously written by Dr Howarth in collaboration with the late Sir John Scott Keltie, a work which is still useful and deservedly popular E W G

Short Reviews

A Text Book of Chemistry By H A Wootton and C W R Hooker Pp xii+488 (Cambridge At the University Press 1933) 6s

THIS textbook bases the justification for its appearance on in particular, the fact that chemistry is a cultural subject and that many pupils will not continue a study of the subject after leaving school It may be said at once that the book is clearly and interestingly written, covering the range of the School Certificate examinations, and emphasises the applications of chemistry to everyday life and the paramount importance of the science in modern industry and manufactures

An outline of molecular theory is introduced immediately after the study of only oxygen, hydrogen and the gas laws then follow atomic theory and formulæ, and, separated by a chapter on water, equivalents, valency and equations Carbon, its oxides and the hydrocarbons are outlined before any of the common elements other than the halogens and nitrogen Although the scope of the book includes the theory of solution and molecular weights of dissolved substances, nothing is said about the periodic classification Experimental work is relegated to the second half of the book, where it is dealt with exclusively The net result is that it is difficult to find or co ordinate particular facts to which one may wish to refer The valuable interpretation of reactions afforded by the broad concepts of oxidation and reduction is largely lost since these concepts are not fully dealt with until after the non metals One would like, moreover, to see more prominence given in an up to date textbook to the generalisation of types of reaction The authors have however carried out their scheme with conviction and the student will have every reason to appreciate the importance of chemistry in all branches of life and industry There are eight excellent photographs as well as the usual line diagrams N M B

The Rise of the Celts By the late Henri Hubert Edited and brought up to date by Prof Marcel Mauss Raymond Lantier and Jean Marx Translated from the French by M R Dobie (The History of Civilization Series) Pp xxv+335+4 plates (London Kegan Paul and Co , Ltd , 1934) 16s net

THIS study of the Celts the result of many years' work, was still incomplete when the author died in 1927 It was completed in part and seen through the press by his friends with the assistance of lecture notes and a draft of the concluding chapter which will appear in a second volume M Hubert had an original outlook , and this was backed by a vast erudition upon which to base a synthetic view of the linguistic, archæological, anthropological and historical material, which it is necessary to master for an adequate discussion of the Celtic problem His analysis of the linguistic evidence, as it appears in this volume, where it is brought to bear upon the place of the Celtic people in relation to other Indo European peoples and on the relation of the Celtic people one to another, is of great value It deserves careful consideration, especially among those who hitherto have shown a tendency to pay too exclusive an attention to archæological evidence It was M Hubert's opinion that anthropology, that is, the study of physical characters in their racial aspect, can give little assistance, and it is a special merit of his study that he insists repeatedly on the distinction between a race', which the Celts were not, and 'a people, which they were, in the sense of a number of groups more or less closely related in a common culture and language In the use of linguistic evidence also he is careful to point out its limitations in arguments on races and peoples

The present volume gives only one half of the story, carrying it up to the Hallstatt period La Tène and the general characteristics of Celtic culture will be considered in the later volume

Geschichte der gegorenen Getränke Von Prof Dr A Maurizio Pp viii+262 (Berlin Paul Parey, 1933) 18 gold marks

Those who hope to glean from the pages of this book authoritative information on modern methods of the manufacture of alcoholic liquors or to learn something about recent theories of fermentation will be disappointed, for it is written mainly from the historical point of view It is, however a veritable encyclopædia of interesting facts relating to fermented beverages from the earliest times to the present day, and from the numerous references quoted, must have involved considerable industry and literary research Not only are the history and geographical distribution of the more common liquors, for example, beer and wine fully described, but similar details are given relating to lesser known beverages, such as mead, spruce beer, koumiss and various berry and herb wines There are also sections dealing with potato spirits and distillation, the latter being illustrated with interesting drawings of primitive distilling vessels

In addition to the account of the beverages themselves, the value of the book is enhanced by the inclusion of references to the basic materials—honey, sugar, herbs, grapes, malt, hops fruits—and to the different implements such as the wine press, used in the production of the various beverages The book concludes with a systematic catalogue of a large number of plants from which fermented beverages have been obtained

A J H G

A Text Book of Inorganic Chemistry By Prof Dr Fritz Ephraim English edition by Dr P C L Thorne Second edition revised and enlarged Pp xii+873 (London and Edinburgh Gurney and Jackson, 1934) 28*s* net

The success of the first English edition of this textbook, published in 1926, has justified the preparation of an up to date version Based upon the fourth German edition, the new issue contains also a good deal of supplementary matter supplied by Prof Ephraim and incorporated in the English text by Dr Thorne The general plan of the work, including the headings of sections and chapters, remains unaltered The revision has entailed an increase of about 8 per cent in the bulk of the book, and in the opinion of the reviewer a further expansion in future editions should be avoided Although by reason of its unusual plan it appears in some respects as predominantly a textbook of the non metals (see **Nature**, 119 7, Jan 1, 1927), the work has proved to be attractive and useful to students who have already secured a grounding in the subject, and the new edition will be welcomed

Sexual Regulations and Human Behaviour By Dr J D Unwin Pp xv+108 (London Williams and Norgate Ltd, 1933) 7*s* 6*d* net

Dr Unwin has made an inductive study of the effect of sexual repression and its relation to progress in human societies, of which this volume is a preliminary statement He has taken eighty societies under review, classifying them according to status as determined by certain characters He finds that the place of each in this grouping agrees with the degree to which pre nuptial sexual relations are subjected to repression, and in a final chapter he rapidly surveys the history of civilisation, showing that decadence has invariably followed the relaxation of sexual regulation While it is more than probable that Dr Unwin is right he has made out a case for further investigation rather than proved his contention No doubt the fuller treatment promised will strengthen the argument

Physical Mechanics an Intermediate Text for Students of the Physical Sciences By Prof R B Lindsay (University Physics Series) Pp x+436 (London Chapman and Hall, Ltd, 1933) 21*s* net

The vector method is followed in this book, and the treatment which usually ends with the mechanical properties of matter is continued to cover the kinetic theory of gases using the virial, the Bohr atom, a particle deflection electrical oscillations and wave mechanics The author s aim has been to make mechanics an introduction to advanced physics, in which he has succeeded admirably

An Introductory Course of Mechanics By E G Phillips Pp viii+255 (Cambridge At the University Press, 1933) 10*s* 6*d* net

The book opens with a short account of vector analysis, going as far as scalar multiplication and the differentiation of vectors The vector method of representation is kept to the fore throughout In this respect it has an advantage over the older books on mechanics, but the mathematics is of a higher order than that acquired by the average student at the time of beginning the study of mechanics However, the book will be of value to many students for the clearness of the treatment and the comprehensive set of examples

The John Murray Expedition to the Arabian Sea

By LIEUT COL R B SEYMOUR SEWELL C I E F R S

SINCE the previous report on the work of the John Murray Expedition (NATURE Jan 20 1934 p 86) H E M S *Mabahiss* has twice traversed the width of the Arabian Sea and in addition has cruised off the African coast between Mombasa and Zanzibar and to the east of Pemba Island

The *Mabahiss* sailed from Bombay on a traverse of the Arabian Sea to Mombasa on December 13 During the whole passage the weather was favourable and good progress was made observations being carried out at 12 stations As we approached the African coast we encountered a strong head current that kept us back somewhat so that we did not arrive in Mombasa until the morning of January 1 1934 We remained at Mombasa until the morning of January 9 and then sailed for Zanzibar in order to report to the Sultan and obtain permission to work off this region of the African coast Unfortunately during the whole of our stay in the Zanzibar area we experienced strong winds and there was a sufficiently heavy sea running to render the *Mabahiss* most uncomfortable while several members of the expedition contracted malaria

One very noticeable feature of the African coast in this region round Mombasa and Zanzibar is the extent to which coastal erosion is and has in the past been going on this is particularly evident on the west side of Pemba Island where most if not all of the bays and inlets are fringed with coral reefs on which small detached islets are to be seen still indicating the limits to which the original land extended in times past though now only the most resistant areas are left This erosion is particularly clearly seen in Chumbi Island about seven miles to the south of Zanzibar At the request of the authorities of the British Museum a visit was paid to this island in order to try to obtain evidence of the presence on the island of the giant robber crab *Birgus latro* the whole island consists of a raised coral rock' the upper surface of which has been weathered into holes and pinnacles by rain while the seaward margins have been eroded and undercut by wave action (Fig 1) The greater part of the island is covered with a profuse growth of a species of *Euphorbia* such as to render a thorough investigation impossible the crab however appeared to be well known to the resident lighthouse keepers and examples have been obtained on other islands in the group

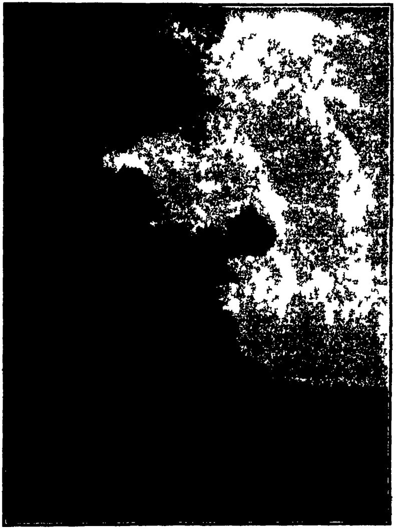

FIG 1 Chumbi Island showing coastal erosion

After leaving Zanzibar on our return passage across the Arabian Sea we encountered moderate winds and seas during the first few days but after that the weather again improved and after calling in at the Seychelles for extra coal we had a comfortable voyage past the Maldive Archipelago to Colombo though owing to a strong head current during the greater part of the journey our speed was considerably reduced During these three cruises we have carried out work at 45 stations, making a total of 135 stations in all up to date

TOPOGRAPHY and BOTTOM DEPOSITS

Lieut Commdr Farquharson, R N, has successfully managed to keep the echo sounder running practically continuously, though towards the end the apparatus required almost constant attention We have thus been able to map more than 5,000 miles of the sea floor along lines on which there were previously few, if any, soundings The late Prof J Schmidt, in his account of the voyage of the *Dana*, put forward the suggestion that there must be a deep ridge crossing the Arabian Sea from the south east towards the north west and connecting the Chagos Archipelago with Socotra and the entrance to the Gulf of Aden, we have now crossed this area twice and there can be no doubt that Schmidt was right On our voyage from Bombay to Mombasa in about long 59° E, a little to the west of where the Admiralty chart shows a sounding of 1,950 fathoms, we crossed a ridge on which the depth of water was only 1,650 fathoms (3,020 metres), though to the north-east the depth fell to 2,400 fathoms (4,392 metres) and to the south west it increased to as much as 2,910 fathoms (5,325 metres) On our return voyage from Zanzibar to Colombo we again crossed this ridge

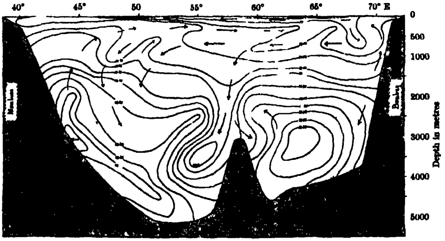

FIG 2 Halogen content of water between Bombay and Mombasa (Cl °/₀₀)

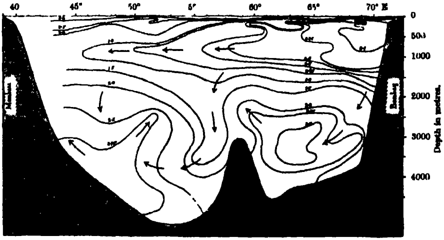

FIG 3 Oxygen content of water between Bombay and Mombasa

After leaving the Seychelles, we found that the bottom was very irregular In about lat 1° 20′ S, long 60° 30′ E we crossed a low ridge on which the depth of water shoaled to 1,570 fathoms (2,873 metres) To the east of this the depth of water increased to 2,600 fathoms (4,758 metres) and then the bottom rose again in a second ridge that lies between long 66° 00′ and 67° 30′ E, and over which there appears to be a general depth of from 1,600 to 1,200 fathoms (2,928 to 2,196 metres), though at two points depths as small as about 900 fathoms (1,737 metres) were obtained, with a deep gully having a depth of some 1,800 fathoms (3,294 metres) between them

Having crossed the first of these shallow areas and thinking that we were in the eastern basin, we carried out a complete station and were fortunate enough to bring up in the trawl a number of rock fragments, one of these has been examined by Mr J S Coates, mineralogist to the Ceylon Government, and he informs me that the rock consists of dolerite, a rock of the basaltic series that is frequently found associated with the Deccan Trap in India, the occurrence of this rock is of particular interest in view of the theory, held by many geologists, that a large section of basalt-covered Gondwanaland now lies submerged to the west of India Between this portion of the ridge and the western side of the Maldive archipelago the depth of water again increased to some 2,300 fathoms (4,209 metres)

It thus seems clear that there are two separate basins in the Arabian Sea one lying to the north east and the other to the south west of the diagonal ridge and it is of interest to note that a bottom sample obtained in the north eastern basin from a depth of 2 352 fathoms (4 305 metres) is of quite a different character from those obtained to the south west of the ridge it was a core 62 inches long of a comparatively soft reddish yellow ooze in which there appears to be very few Foraminifera and it seems probable that this is the type of deposit that Sir John Murray showed to lie between lat 5° and 12° N and long 62° and 72° E and classified by him as red clay though the depth is much less than would be expected for such a deposit

HYDROGRAPHIC OBSERVATIONS

During our voyage from Bombay to Mombasa and again during the return voyage from a point about lat 7° 30 S long 44° 10 E past the Seychelles to the entrance to Kardiva Channel in the Maldive Archipelago lines of hydrographic stations were run across the Arabian Sea The results obtained in the first of these traverses have now been tabulated and are given in Figs 2 and 3 In this section between Bombay and Mombasa there appear to be a series of currents and counter currents in the upper levels A study of the halogen content (Fig 2) shows that on the surface the water is streaming towards the south west under the influence of the north east monsoon wind while immediately beneath this upper stratum there is a counter current in the opposite direction at a depth of some 136 fathoms (250 metres) At a still deeper level approximately 400 fathoms (732 metres) the current is again moving towards the west but in long 68° E this mass of water becomes deflected downwards In this connexion it is interesting to note that in the region to the east of the Arabian Sea there are indications of a similar deep current at about the same depth and moving in the same direction*

As already mentioned the presence of a deep ridge separates the Arabian Sea into two basins and it is into the south west basin that the greater part of this descending mass of water is directed In each basin a mass of water of low salinity was detected that is almost certainly derived from the great antarctic bottom drift A study of the oxygen content of the water (Fig 3) at the different levels and at different stations gives an almost identical picture of the movement of the water masses the descending mass of tropic water with a low oxygen content being clearly distinguishable from the antarctic polar water in which the oxygen content is relatively high and in each basin there appears to be a vertical rotatory movement in progress the water on the eastern side passing downwards towards the bottom

Our work off Bombay has now made it possible to trace the movements of the water masses into and out of the Gulf of Oman (Fig 4) The main interest is the flow of water of a high halogen content (20 0 and above) out of the Persian Gulf towards the south east At the head of the Gulf of Oman this mass of water lies at a depth of 110–160 fathoms (200–300 metres) but as it is followed out of the Gulf it can be seen to sink gradually until off Bombay it is lying at a depth of 382 fathoms (700 metres) At a series of stations off Bombay we encountered the same or a very similar type of deposit to that found in the curious azoic region in the Gulf of Oman referred to in the earlier report of the Expedition The deposit from a depth of 156 fathoms was similarly though to a rather less extent than off the Arabian coast impregnated with sulphuretted hydrogen and here too the result of three trawls yielded remarkably little in the way of animal life

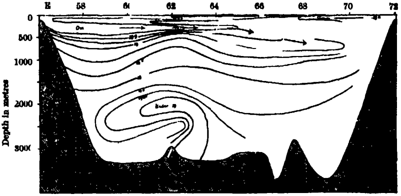

FIG 4 Halogen content of water in the Gulf of Oman (Cl)

BIOLOGY

The region of the African coast under investigation proved to possess a very rich fauna and good catches were made at a number of stations in water the depth of which ranged from 100 to 500 fathoms (183 to 915 metres) In shallower depths our nets were badly torn by coral while in depths greater than 660 fathoms (1 200 metres) there seemed to be evidence of a distinct falling off in the quantity of life at the bottom Sometimes large catches were made thus at one station at a depth of 802 metres an hour s haul with the Agassiz trawl resulted in our securing a hundred examples of a species of *Phormosoma* probably *P indicum* and masses of a species of *Virgularia* At another station we secured some 114 examples of fish belonging to about twenty species and nearly as many genera , together with some 58 asteroids and about 700 examples of an ophiuroid

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* Sewell, R B Seymour 1932, Geographic and Oceanographic Research in Indian Waters Part VI Temperature and Salinity of the deeper waters of the Bay of Bengal and Andaman Sea *Mem Asiatic Soc Bengal* 9 No 6. See pp 377–378

The general richness of the fauna provided a very marked contrast to the comparatively barren region round the Arabian coast and the azoic area of the Gulf of Oman Until the collections have been worked out, it is impossible to give any details of the fauna of this African region, but the general impression created is that this region round Mombasa and Zanzibar has a fauna much more nearly allied with the fauna of the southern coast of the Gulf of Aden than with that of the northern coast of the Gulf

Chemistry and Chemists in Spain

AT the tenth meeting of the Union Internationale de Chimie held at Liège in 1930 apart from formal business, an adequate amount of time was devoted to consideration of problems connected with the constitution and properties of the simple and complex carbohydrates Comprehensive papers previously circulated by recognised authorities prepared the way for useful discussions, and only in one or two cases was discussion rendered impossible by the tedious reading by authors of long manuscripts which either had been or should have been circulated previously In spite of one or two drawbacks, the Liège meeting indicated how scientifically useful such international meetings may be when suitably organised

When the invitation to hold the eleventh meeting of the Union in Madrid was accepted it was decided by leading Spanish chemists to revive the pre War International Congress of Chemistry at the same time, with the object of consolidating the scientific side of the meeting The last meeting of the International Congress was held in Washington in 1912 and the meeting, postponed from 1932 to 1934, held in Madrid (April 5–11) constituted the Ninth International Congress Some confusion may have arisen even among those attending that Congress and the eleventh meeting of the Union Internationale

In spite of all the difficulties which have attended their work of organisation during the last two years, our Spanish colleagues have entertained their guests with lavish hospitality, both scientific and otherwise The Congress and the meeting of the Union were opened in the ultra-modern Salle Capitol in the presence of the president of the Spanish Republic, who made what appeared to be an impressive speech in Spanish after the reading in Spanish by Prof Fernandez of an account (previously circulated) of the developments in chemistry since the Eighth Congress There were about 1,200 on the list of ordinary members of the Congress This list included also the ladies who were kept busy enjoying the artistic and other treasures of Madrid, while the chemists were supposed to be busy discussing some of the 245 scientific communications, attending the four special lectures such as that of Prof G N Lewis on "The Different Kinds of Water" and listening to the twenty special papers such as those given by Profs P Walden ('Anomale Elektrolyte in nichtwässerigen Lösungen"), G Barger ("On the Alkaloids of the *Iso*chinolin Group '), R Robinson (Molecular Architecture of Plant Products"), R H Kruyt ('The Modern Development of Colloid Chemistry ') P Karrer (Untersuchungen uber Carotinoide und Vitamine") and Miss Jordan Lloyd (The Chemistry of the Tanning Process with Special Reference to Vegetable and Chrome Tanning) the only lady chemist taking a leading part in the last two groups of special papers Nearly all the communications to the Congress were circulated beforehand and intended to be the basis of discussion

This huge scientific programme was interspersed with receptions by the president of the Republic at the National Palace and by the Mayor of Madrid at the Town Hall, visits to Toledo and Segovia and artistic entertainments terminating with a well attended banquet One heard also of several official or semi official lunches and dinners and of private excursions before the dispersal of the delegates to the many places of interest in the south of Spain and even to Morocco Everywhere the members of the Congress were most kindly and graciously received and, apart from the somewhat adverse climatic conditions in Madrid, there was no sign anywhere of discomfort, alarm or even disquietude The graciousness of our hosts was shown in a more permanent fashion by the conferring of honorary doctorates of the University of Madrid on seven delegates, among whom are Profs H E Armstrong and R Robinson, the election of ten foreign members of the Spanish Academy of Exact Sciences, among whom is Prof G Barger and, finally, the conferring of the new Order of the Spanish Republic on another eight delegates, among whom is Prof E Bulmann, president of the Union Internationale

The permanent result of the Ninth International Congress is not easy to forecast Many hope that its scientific proceedings will not be buried in a separate huge volume, but will find their way into more accessible journals devoted to the publication of contributions to chemical knowledge

The meeting of the Union Internationale seemed to be overshadowed and was confined to two sittings of the Council and one of the Bureau, apart from those of several of the committees In formal business, Prof N Parravano (Rome) was elected to succeed Prof Bulmann in the presidency and the new members of the Bureau are Profs M Bodenstein (Berlin), E Bartow (Iowa), F Fichter (Basle), K Matsubara (Tokyo) and W Swietoslawski (Warsaw) The decision to accept the invitation to hold the twelfth meeting of the Union in Switzerland in 1936 was confirmed

The chief subject of discussion by the Council concerned future arrangements for organisation concerning chemical nomenclature The existence of separate committees for organic and biochemical nomenclature has for some years been regarded as unfortunate by many chemists in different countries, and the British Federal Council for Chemistry has been active in trying to have the two committees combined The tone of the discussion was somewhat heated, and 'Anglo Saxon' opposition to the existing committee on biochemical nomenclature was referred to in terms which created an atmosphere scarcely suitable for critical consideration of the best policy regarding a question of fundamental importance in chemistry

The following proposals by Prof F Swartz were submitted "In conformity with the decision of the Union the Committees on nomenclature are dissolved The Council decides to constitute three new committees on nomenclature, one for inorganic chemistry, one for organic chemistry and one for biochemistry These committees are asked to present a scheme of organisation of the future work of the committees on nomenclature to the Union before 31 December, 1935 Their presidents will assure the co ordination of the work of these committees The members of the committees will be chosen as far as possible from among the members of the former committees These proposals were voted on according to countries adhering to the Union and passed by 29 to 28 votes That there should be five members of each commission was again voted on in the same manner and passed by 31 to 27 votes It was finally left to the Bureau to choose the members of the committee

It may be questioned whether decisions of such a nature should be determined by countries having a number of votes based on their population and not by individual votes of representative chemists keenly interested in the matter, but an important advance will be made if, by 1936, the relative positions of organic chemistry and biochemistry on the question of nomenclature common to both are satisfactorily defined C S Gibson

Aberdeen Meeting of the British Association

THE preliminary programme of the meeting of the British Association to be held at Aberdeen on September 5–12 has now been issued In certain respects a university city affords the best and most appropriate setting for a meeting of the Association, and Scottish meetings are anticipated with pleasure, for their standard of organisation has always been high, and they have always attracted a notable measure of public interest

In Aberdeen, the accommodation for the sessions will be very convenient, for eight of the sections will be housed in Marischal College, and of the rest, four will find rooms within a quarter of a mile of the College Only the Section of Botany will sacrifice nearness to the centre to the convenience of meeting in the appropriate department of the University, with its fine gardens, at St Machar The Reception Room will be in the Music Hall, a building of special historical interest to the Association, for it was opened in 1859, and the first ceremony which took place in it was the inaugural meeting of the Association in that year, when the Prince Consort occupied the chair He conveyed a message from Queen Victoria to the Association, and delivered an address which is a pronouncement of no little interest in the history of science His own sympathetic and well-informed attitude toward science is well known, and is clearly defined in this address, and no less clearly is indicated the general position of science in the life of the community at that time

This point is apposite to the present programme, since particular contacts between science and the life of the community will be more prominent as subjects of discussion at Aberdeen than they are usually Such topics are of course, always to be found in Association programmes, but in recent years, and especially last year at Leicester, it has become clear that lay members and those who follow the proceedings of the meeting in the Press wish to hear more of them It seems natural and proper that this should be so, and it is obviously within the stated objects of the Association that such a demand ought to be met It is announced in the preliminary programme that 'several Sections are including in their programmes papers or discussions within the scope of the resolution forwarded by General Committee to Council at the Leicester Meeting last year, on the relation between the advance of science and social progress', and a number of appropriate subjects are already announced If from some of these there should emerge at Aberdeen applications for the appointment of committees to pursue investigations this will mean that the Association's machinery is being used for the advancement of science in specific directions of public importance There will be nothing new in this The Association's record affords sufficient evidence for that statement But the giving of "a more systematic direction" to scientific inquiry was one of the charges laid upon the Association by its founders, and here, surely, is a systematic direction which has been rightly pointed out and will be rightly followed

Sir James Jeans, who has succeeded the late Sir William Hardy as president of the Association, announces the title of his address as The New World Picture of Modern Physics" It is stated that one of the usual evening discourses will be given as a Sir William Hardy memorial lecture, and will deal with the preservation of meat, fish and fruit, a subject peculiarly appropriate to Aberdeen, where the work of the Torry Research Station is very well known The name of the lecturer is not yet announced The other evening discourse will be given by Prof W L Bragg on "The Exploration of the Mineral World by X Rays" Reverting to the subject of science and the community, the programme states tentatively that an evening symposium on the general relations of these may be arranged The sectional programmes, so far as can be judged from the short summaries furnished in this preliminary announcement, are certainly no less wide ranging than usual An ambitious series of excursions is under consideration and inasmuch as the occasion of a meeting in a centre commanding this part of Scotland must needs be rare, the opportunity should be taken

This programme is accompanied by a circular addressed to those who are not life-members of the Association, which in effect asks them to pay regular subscriptions to the Association by signing a banker's order form, whether they attend the meetings regularly or not The hope is to assure a more stable income for the Association, and thus 'alleviate the difficulty of allocating grants in aid of important research", for which the applications habitually exceed the sums available The Association's support of research, and the preparation of reports on the state of science", which began in 1834 and has never since been intermitted, sufficiently justifies this appeal

Obituary

DR WALTER ROSENHAIN, F R S

IT is a grief and a shock to me on returning from a holiday abroad to read of the death of Walter Rosenhain I have had many pupils but none more gifted with the imaginative insight of the discoverer more discriminating in criticism, or more skilful in the technique of the experimentalist He came to me, in the late nineties with a research scholarship from the University of Melbourne, when I was professor of mechanism at Cambridge, and asked me to suggest a piece of research which he might undertake in my laboratory At that time Roberts Austen, Arnold, J E Stead Osmond and others were applying to metallurgical analysis the microscopic methods which had been initiated by Sorby in his earlier study of metals and it was beginning to be recognised, somewhat vaguely, that the irregular grains which a polished metal revealed in the microscope were crystals the boundaries of which had interfered with one another in the process of crystal growth I suggested to Rosenhain that this opened up a good field, and that it would be interesting to see what happened when a plastic metal was overstrained The supposed crystal grains must alter their form, but how ?

Rosenhain had already begun in Melbourne a research on steam jets which he was anxious to finish first, and we arranged that as soon as he had completed that he should take up the metallurgical inquiry This was done, and I recall very vividly how, after he had acquired some skill in polishing and etching metallic surfaces so as to bring out the granular structure, we put a plastic strip one day under the microscope, fixed in a straining stage so that it could be stretched while one watched the surface of the grains As the straining proceeded we saw lines appear, sharply defined parallel lines which were black in the reflected illumination, becoming more numerous the more the specimen was stretched, and tending to develop criss cross patterns The laboratory was closing for the day, so we went our several ways, each brooding on what these curious lines might mean That evening I saw the interpretation the lines must mean finite slips, taking place on parallel layers within the grain Consequently the grains *were* definite crystals, and remained crystals after the deformation they gave way, when the straining passed the elastic limit, by the sliding of bands or layers on a group of parallel planes much as a pack of cards might be sheared Slips of this kind in three directions inclined to one another within each grain would allow the grain to assume a new form consistent with the plastic straining of the piece as a whole Next day we met again, and I found that Rosenhain had, quite independently, come to the same conclusion That was the discovery of 'slip bands' which we published jointly in a preliminary notice to the Royal Society in March 1899 (*Proceedings*, vol 65), and later (along with much more) in the Bakerian Lecture of that year (*Phil Trans* , A, vol 193, p 353)

We pursued the research hotly together It was a happy as well as a fruitful association To work with such a pupil was, for the professor, a rare delight and a constant stimulus It turned out that metallurgy did offer to Rosenhain the most congenial field that could have been chosen Looking back now, I feel a natural pride in having guided him to it Afterwards, when the days of pupillage were past, I had the continued pleasure of watching him go on from strength to strength and receive growing recognition, of visiting him from time to time at the National Physical Laboratory where he made a position worthy of his powers, and of listening to his admirably lucid expositions, public or private An old man, such as I am, must reckon with the loss of his contemporaries, but it was far too early for us to lose Walter Rosenhain J A EWING

DR WALTER ROSENHAIN, whose death at the early age of fifty-eight years occurred on March 17 last, had a world-wide reputation as a metallurgist, and for more than thirty years had taken a leading part in the development of the new science of metallography Born in Melbourne, Australia, on August 24, 1875, he graduated in engineering at the University of Melbourne, in 1897 and proceeded to Cambridge as the holder of an 1851 Exhibition Scholarship Here he worked with Prof (now Sir Alfred) Ewing, and began to use the microscope in the study of metals In 1899 appeared a memorable joint paper, describing in detail the mechanism of deformation of metals by slip, which has formed the basis of all later work on the subject

Rosenhain then entered the works of Messrs Chance Bros , and for about six years was engaged in work on optical glass, although continuing his studies of metals His well known textbook of Glass Manufacture ' was first published in 1908 a second edition being called for in 1919 In 1906 he became superintendent of the Department of Metallurgy at the National Physical Laboratory succeeding Dr (now Sir Harold) Carpenter This post he held for twenty five years, during which time the staff increased from four to about seventy, whilst the long series of important communications which issued from the Department under his direction was evidence of his success in guiding and inspiring his collaborators, his loyalty towards whom was unfailing This work covered a wide range His own interests lay chiefly in the field of what he preferred to call "Physical Metallurgy' (the title of his textbook published in 1914)—the study of the properties of metals and alloys in relation to their structure

On the practical side, perhaps the most striking achievement during this period was the work on the light alloys of aluminium, largely conducted in view of the requirements of the War, and carried out under conditions of urgency The results were of great importance for the progress of air craft construction, and the Eleventh Report of the Alloys Research Committee, in which they are recorded, marks an epoch in the development of the alloys of aluminium

This Committee, established by the Institution of Mechanical Engineers, was later transformed into the Alloys of Iron Research Committee, and a series of studies of the binary alloys of iron with other elements was begun, special attention being given to the production of the elements used in the highest state of purity Such work involved the introduction of new methods of research at high temperatures, and the improvements of technique have done much to smooth the path of future investigators

On the theoretical side, Rosenhain was particularly associated with conceptions regarding the behaviour of metals on deformation and when undergoing thermal treatment The hypothesis of an 'amorphous' phase, existing between the crystal grains of a cast metal and in the deformed portions of crystalline metals, was applied by him with the greatest ingenuity to explain creep and other effects depending on time and temperature

As a lecturer and debater on metallurgical subjects Rosenhain was unrivalled He could give an account of experimental work or expound a theory in simple language, with a fluency which never hindered the logical arrangement of the steps in his argument, whilst his quickness of thought and skill in debate gave interest to his frequent interventions in metallurgical discussions He was often involved in controversy, and could be scathing in his criticisms, but maintained an even good humour under all conditions In 1931 he retired from his post at the National Physical Laboratory, and until his death carried on a successful practice as a consulting metallurgist, without slackening his scientific activities

Rosenhain was elected a fellow of the Royal Society in 1913 He was active in the formation of the Institute of Metals, of which he was president in 1928–30, also delivering the May Lecture in 1923 He received the Carnegie Medal of the Iron and Steel Institute in 1906 for an early research on the strength of steel at high temperatures, a subject which he pursued with great success at the National Physical Laboratory, and was awarded the Bessemer Medal in 1930 His fluency in French and German made him a valuable link with foreign metallurgical bodies, and he took a special interest in the International Association for Testing Materials of which he became president, and would have presided at the congress planned to take place in London in 1935 On such bodies, and on committees of the British Standards Institution, his clear ideas as to what should be done and his courage in maintaining his opinion gave great weight to his collaboration

Dr Rosenhain is survived by his wife, a sister of the late General Sir John Monash of Melbourne, and by two daughters

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PROF S H VINES, F R S

WITH the death of Sidney Howard Vines at the age of eighty four years, another leading botanist of the older generation has passed away Though he had lived in retirement at Exmouth since 1919, his help and advice were not infrequently sought, and he still took an active interest in botanical matters

Born in London in 1849 and educated at a private school, Vines afterwards entered Guy's Hospital, but gaining a scholarship to Cambridge he went up to Christ's College in 1872 Being somewhat more mature than the average undergraduate, and having some preliminary training in science, he distinguished himself already in his undergraduate years and as such was offered in 1874 the appointment of demonstrator in Huxley's course of general biology at South Kensington As he says in the Huxley Centenary number of NATURE (1925), Huxley's lectures were a revelation to him, so lucid, so well proportioned, so convincingly expressed. Altogether it was a memorable and an invaluable experience in the art of teaching. In the following two years the botanical portion of Huxley's general biology course was given by Thiselton Dyer, and in both courses Vines acted as demonstrator.

In 1875 Vines graduated with first class honours in botany and in the following year was elected fellow and lecturer of his College. By way of equipping himself still further for his future work he decided to visit some well known German laboratory and having been stimulated while at Cambridge by the teaching of Sir Michael Foster, desired to devote himself to the physiological side of botany. He was anxious therefore to study under Julius Sachs, then at the zenith of his activity and fame as a plant physiologist, and having obtained leave of absence for the Easter term of 1877, he spent this time at Würzburg under the stimulating direction of Sachs, taking up the study of the growth of plants in relation to light. In an account he published some years ago of his studies abroad he tells us that Sachs's lectures were "delivered with such lucidity and force that familiar things became instinct with new life". He formed a lasting friendship with Sachs and was both the instigator of, and a generous donor to, the fund which was raised a few years ago to acquire the portrait of Sachs for the Linnean Society.

On his return to England, Vines started a botanical laboratory in Cambridge through the kindness of Sir Michael Foster, who lent him a room in the newly erected Physiology Laboratory. Later, when he was appointed reader in botany at Cambridge, more permanent accommodation was provided in the ground floor of the Botany Department. But though now provided with a laboratory, then an innovation, Vines found that he could not do justice to the practical side of the various branches of botany and felt particularly, as he tells us, the need of acquaintance with methods for the study of fungi. He consequently decided to visit the laboratory of De Bary, the eminent mycologist. In 1880 he obtained two terms' leave of absence and spent the beginning of this time with De Bary, but the greater part with Sachs at Würzburg. Thus, in those early days when there were no facilities for practical work in botany in Great Britain, Vines obtained the necessary training for the development of practical botany on his return. Other leading botanists of those days like D. H. Scott, Marshall Ward and F. O. Bower did the same. They sought and found in Germany what was at the time unobtainable in England.

In 1883, Vines was appointed reader in botany in Cambridge, and when the Sherardian chair in Oxford became vacant in 1888, he was appointed successor to Prof. Bayley Balfour. The chair of botany at Oxford had been held by a number of distinguished men and botany had received no small encouragement at the hands of the University. Still, Vines considered it necessary in his inaugural lecture to put in a further plea for botany as an academic subject, actuated in part by a desire to meet the severe and unsympathetic attitude of Ruskin, who a few years previously had criticised "the vulgar and ugly mysteries of the so-called science of botany". As Vines said, he felt these strictures all the more keenly because of his deep sense of indebtedness to Ruskin "for much that adds charm and interest to life".

For thirty-one years, until his retirement in 1919, Vines held the professorship with distinction, witnessing the growth in importance of botany in the University curriculum and the addition of the cognate school of forestry, the organisation of which entailed considerable addition to his duties. His interest in the practical side of botany led to the publication, in conjunction with Prof. Bower, of a most useful "Course of Practical Instruction in Botany" in 1888. He adapted a leading German textbook of botany by Prof. Prantl for the use of English students (1895). In 1886 he had already published his excellent course of "Lectures on the Physiology of Plants", which was for long the standard English book on the subject.

Though primarily a physiologist, Vines was interested in the valuable herbarium of the University of Oxford and with the help of Dr. Claridge Druce published an account of "The Dillenian Herbaria" (1907) and later of "The Morisonian Herbarium" (1914), both full of interesting historical and biographical matter. For many years Vines was one of the editors of the *Annals of Botany* to which he contributed numerous papers on physiological subjects. The earlier of these dealt with more general problems such as root pressure and transpiration, the mechanism of the stomata, epinasty and hyponasty; the later ones were concerned with proteolytic enzymes, and this latter series taken together give an excellent account of the occurrence and function of the proteases in the vegetable kingdom.

Vines always preserved, however, a general interest in botany, as is shown by his article on "Plant Morphology" in the eleventh edition of the "Encyclopædia Brittanica", which is still well worth reading. He naturally refers in it to Sachs's theory, that morphological differences are the expression of differences in material composition, and though this theory had to be considerably modified, he held that the discovery by Sachs that a small quantity of a substance can affect the development of an entire organ, foreshadowed the subsequent discovery of growth-promoting substances or hormones.

Vines's eminence in botany was recognised by his election to the Royal Society in 1885, while still reader at Cambridge. He joined the Linnean Society in 1878 and acted as president in 1900–4. A good portrait of him by the Hon. John Collier hangs in the rooms of the Linnean Society.

Both when in Oxford and afterwards during his retirement at Exmouth, Vines took a keen interest in his garden, devoting himself with skill and enjoyment to the cultivation of plants Unfortunately, his health latterly left much to be desired, and he passed away on April 4

The charm of Vines's personality gained for him a large number of warm friends among his colleagues, and botanists of a younger generation will always be grateful to him for the kindliness with which he treated them and the ever ready help he so willingly extended to them

F E W

DR MARIA A VAN HERWERDEN

THE cause of biological sciences as linked to the evolution of man has sustained a severe blow in the death of Dr Maria Anna Van Herwerden on January 26 at Utrecht, where she had long taught in the University in the Department of Embryology, Cytology and Genetics From its early days she was a leader in the International Federation of Eugenic Organisations, as well as being one of the first supporters of the International Union for the Scientific Study of Population Problems, and had a wide circle of friends in Great Britain In Holland her foresight and untiring work contributed much to building up the Central Committee of societies working in the field of human genetics, which resulted in the foundation last year of the Netherlands Institute for Research in Human Genetics and Race biology *Mensch en Maatschappij*, No 2, says of her "She was a modest woman, never putting herself forward, without self seeking, simply serving the cause for which she stood, with great enthusiasm and devotion her strong will and sense of duty found her always ready with help and advice Her counsels always carried the greatest weight, founded as they were on wide knowledge illumined by clear insight and judgment and presented sympathetically as the outcome of a benevolent spirit in clear cut elegant form the Sciences of Human Genetics and Eugenics have lost their most outstanding exponent in our country in the passing of this courageous and talented woman "

WE regret to announce the following deaths

Prof R Chodat, since 1889 professor of botany in the University of Geneva, rector of the University in 1908–10 and first president, in 1901, of the Association Internationale des Botanistes, aged sixty nine years

Sir George Duckworth, C B, secretary of the Royal Commission on Historical Monuments (England) in 1908–33 on April 27, aged sixty six years

Prof W H Welch, emeritus professor of the history of medicine and emeritus director of the School of Hygiene and Public Health at Johns Hopkins University, Baltimore, on April 30, aged eighty four years

Mr W G Whiffen, manufacturer of drugs and fine chemicals, one of the original fellows of the Institute of Chemistry, on April 28, aged eighty-two years.

News and Views

Prof C V Boys, F R S

PROF C V BOYS, who is delivering the Guthrie Lecture of the Physical Society on May 4, is the doyen of physicists of what may be called the classical age of experimental physics In one of his earliest researches he succeeded in photographing rifle bullets in flight To Boys we owe the production of quartz fibres, those almost invisible threads having remarkable elastic properties which are indispensable in many galvanometers, etc Boys produced them very simply by shooting an arrow, to which a short piece of partially fused quartz was attached, across the room, the unfused part being held behind Employing these fibres, Boys was able to eliminate most of the errors of the Cavendish experiment and succeeded in weighing the earth with an accuracy neither before nor since surpassed His experiments with bubbles set out in his fascinating book Soap Bubbles and the Forces that mould them' are still an unfailing source of interest to old and young Telescope design, sun dials and a camera for following a lightning flash throughout its course, have also occupied his attention With the passage of the Gas Regulation Act, 1920, the design and construction of a calorimeter for measuring and recording the calorific value of towns' gas became a matter of urgency Boys had already invented a gas calorimeter, but the step from a snap test device to a recording instrument was a long one. Boys succeeded, however in constructing such a recorder, and it has been in continuous use recording the calorific value of gas supplied in certain parts of the country The instrument incorporates a very large number of most ingenious but typically Boysian' devices To mention but one, a thinking machine' automatically corrects the volume of gas burnt in the calorimeter to normal temperature and pressure and continually records the correcting factor

Research and Development Lectures

WITH the object of promoting attention to the importance of research—both purely scientific and technical—and the utilisation of its results in the service of mankind, the British Science Guild arranged last year for the delivery of a Research and Development Lecture by Sir Harold Carpenter on "Metals in Industry" It was originally intended that one such lecture should be delivered annually, but Lord Melchett, president of the Guild, has given the scheme much wider national significance by arranging several discourses in which the broad trend of scientific development of subjects will be illustrated by experiments and practical demonstrations By kind permission of the managers, the lectures will be delivered in the historic lecture theatre of the Royal Institution. The first of the lectures, at which the Prime Minister will preside, is to be delivered as we go to press, on Wednesday, May 2, by Sir William Bragg on 'The Development of the Principles of Refrigeration", and the second, on Wednesday, May 30, by Lord Rutherford on 'Helium and other Rare Gases". It is hoped to arrange for two further lectures of the same type to be delivered in the autumn.

The particular aim of these Research and Development Lectures is to enable legislators, administrators and other responsible leaders to make contact with outstanding achievements of practical science. There is no lack of interest in scientific work and thought among most of these representatives of progressive national life, but few lectures have been specially designed to appeal to them. Lord Melchett's action in providing for such lectures has, however, been warmly supported by men of science and laymen alike and we congratulate him and the British Science Guild upon the success of a notable national endeavour.

Progress of Automobile Engineering

For the James Forrest Lecture which he delivered at the Institution of Civil Engineers on May 1, Sir Henry Fowler took as his subject "The Progress of Automobile Engineering". After a tribute to Forrest, whom he had known when a student, Sir Henry said that to-day the automobile industry is the fifth in point of size in Great Britain, while in the United States in 1928 the industry used no less than 6,000,000 tons of steel. The industry is also one of the greatest consumers of rubber, cotton and light alloys. The first self-propelled vehicle was that built in 1769 by Cugnot, and this was followed by those of Murdoch and Trevithick. Between 1823 and 1840, many patents were taken out for steam carriages, and the same period saw the experiments of Hancock, Gurney, Dance and others. Of the details then invented, the chain drive and differential gear of Hills and the steering gear of Gibbs has survived. Prohibitive tolls, vested interests and the railways, however, led to the abandonment of these early experiments and then came the 'Red Flag" Act of 1865, with restrictions which were not removed until 1896. But the matter was taken further by the work of Otto in 1876 and Daimler in 1883, the latter giving us a power unit which has changed our lives, much as the railway did a century ago. The outstanding personality of the early period of automobile development was Levassor, whose arrangement of the various parts of a motor car has been followed generally. Progress from about 1895 until 1901 can be traced from the records of trials, one of the most important of these being that held by the Royal Automobile Club in 1900, when eighty-three cars, most of foreign origin, started on a 1,000 miles run.

A great part of the lecture was devoted to the details of the subject—materials, tyres, engines, gears, clutches, springs, brakes, etc. Improvements in materials have been continuous and have led to the introduction of various alloy steels and alloys of aluminium such as duralumin, "Y" alloy and that known as "R R". The investigation of these light alloys has led to an almost new technique. Recently, success has been achieved with a lead bronze alloy for bearings. As for the tyres, pneumatic tyres were first conceived by Thomson in 1846, and developed by Dunlop in 1888 and first made for motors by Michelin and Co. In 1906 it was said that tyres cost "perhaps five or six times what the fuel cost per mile run", but the cost to-day is probably less than one quarter of the cost of fuel. In engine design the greatest advance of recent times has been the development of engines for using heavy oil. Compared with the petrol engine, the compression ignition oil engine is slightly heavier, but has a higher efficiency and greater turning moment at low speeds. The problem of transmission, perhaps, is given more consideration to-day than any other. Many alternatives to the 'crash' gear have been tried, and not only in automobile but also in other classes of engineering, the matter has proved one of the most difficult problems in mechanics to be solved at a low cost and with high efficiency. In connexion with this part of his subject, Sir Henry described the Wilson gear, the Austin Hayes gear, the Leyland hydraulic converter, the so-called fluid fly-wheel and the automatic clutch manufactured under the Newton patents. He also touched upon types of brakes, and methods of suspension, and in his conclusion recalled the remark of a friend that in early days cars were extremely simple and extremely unreliable, whereas at the present time they are extremely complicated, but leave nothing to be desired so far as reliability is concerned.

Spicer-Dufay Colour Film

Since 1926 the Spicer-Dufay process of colour photography has been the object of very intensive research and a demonstration of colour films made by this process was given at a Royal Society soirée in 1931 (see Nature, May 30, 1931, p. 821). It is stated that the new product will shortly be marketed for 16 mm. cinematography, and later it is intended to supply also roll films for ordinary cameras and standard 35 mm. cinematograph film. The new film consists of a transparent base on which is first coated a three-colour mosaic of regular pattern; in intimate contact with the colour mosaic screen is a very thin waterproof layer and above this is a highly sensitive panchromatic photographic emulsion. Exposure is made through the film base and colour mosaic. A positive image is formed by reversal. In principle, the process is thus similar to many which have long been operated with great success for still photography in colour.

The application of this general principle to cinematography has necessitated a very thorough study of every detail of the process. For example, in still photography it has been found quite satisfactory to use an irregular colour mosaic, the primary coloured elements being distributed in an entirely haphazard manner, it is reported that when this type of mosaic is used for cinematography, the superimposition of successive pictures built up of colour elements arranged in entirely different ways gives rise to a very unpleasant effect known as 'boiling', every part of the picture on the screen appearing to be in rapid internal movement With the Dufay regular mosaic this trouble does not occur The success of a process for colour cinematography depends on a variety of factors besides its power to yield pleasing coloured pictures Two very important desiderata are that films should be capable of projection with normal projectors as used for ordinary black and white pictures, and they must be capable of yielding coloured duplicates by a process of automatic printing In respect of the first of these requirements, the Spicer Dufay process has already achieved its object and the luminosity of the projected pictures is at least adequate, while a method of duplicating by machine printing is now available The process is therefore one in which technical achievement is already very high

Royal Institution and Davy Faraday Laboratory

THE annual meeting of the Royal Institution was held on Tuesday, May 1, under the chairmanship of the treasurer, Sir Robert Robertson The Visitors' Report for the year 1933 showed a substantial addition to the membership, the total (1020) at the end of the year, including honorary members, members and associate subscribers, being the highest reached since the War The following officers were re elected *President*, The Right Hon Lord Eustace Percy, *Treasurer*, Sir Robert Robertson, *Secretary*, Major Charles E S Phillips The fulfilment by the Trustees of the Rockefeller Foundation of their promise, made in 1930, to give £20,000 for endowment of research in the Davy Faraday Laboratory, was publicly announced some months ago In the Visitors' Report reference is made to this and other gifts to the Research Endowment Fund which has now been established at the Institution, and the Report of the Davy Faraday Laboratory Committee, which is printed with the Visitors' Report, gives interesting evidence of the work which is in progress with the funds now available from this and other sources

THE majority of the workers in the Davy Faraday Laboratory are engaged, under the direction of Sir William Bragg, in a combined effort to map out exactly the spatial distribution of the atoms in organic molecules", using X ray methods An X ray tube with revolving anti-cathode has been in regular use now for about two years, and a much larger tube, to operate up to about 50 kw, is in the experimental stages With these powerful sources, very small crystals can be used, and in recent work successful photographs have been obtained with crystals weighing less than one twenty fifth of a milligram From large numbers of reflection measurements calculations can be made, using a method based on the Fourier principle, of the electron density at every point within the crystal The result is given in the form of contour maps Each contour line shows the electron density expressed in whole numbers of electrons per cubic Angstrom unit The map is in general accurate to the width of a line " This interesting method of mapping the molecules is illustrated in the Report by a contour map of the durene molecule, taken from a recent paper by Dr J M Robertson, one of the workers in the Laboratory

Rotation of the Earth

ON May 1, a public lecture was delivered at Oxford by Dr J K Fotheringham, reader in ancient astronomy and chronology in the University, on the rotation of the earth Dr Fotheringham spoke of the importance of the fact of rotation in regard to such practical matters as the alternation of day and night, the march of the seasons, the tides, and the measurement of time Some of the Greeks, perhaps including Plato held the Pythagorean view that the earth and not the sky rotated, but in either case the rotation was generally held to be uniform The fact of precession was known to Hipparchus, but may be an older discovery A further disturbance of uniformity, namely, nutation, with a period of 19 years, was determined by Bradley at Oxford Since his time, further changes have been measured, such as a shifting of the position of the pole in relation to the earth's figure, this has a period of 15 months and may affect latitude to the extent of two fifths of a second of arc A change in the speed of rotation is no doubt a real physical fact, the day is getting longer by one second in many thousand years" The apparent acceleration of the sun is modified by that of the moon Fresh facts bearing upon this have been collected by Dr Fotheringham and others, but their full explanation awaits further research

Chemical Patents Committee

A CHEMICAL PATENTS COMMITTEE of the Department of Scientific and Industrial Research has been appointed to advise on the patenting and exploitation of results of the Department's chemical researches that may have industrial possibilities The Committee is the result of negotiations that have been taking place for some time between the Department and various industrial organisations with the object of promoting closer co operation and of avoiding unnecessary overlapping It is hoped that one result of the Committee's advice will be that research results may be brought to the notice of industry and translated into practice at an earlier stage than hitherto, and under conditions that will take existing industrial activities into account Sir Frank Smith, secretary of the Department of Scientific and Industrial Research, will act as chairman, and in addition to departmental members, the Committee will include Mr F H Carr and Mr J Davidson Pratt, representing the Association of British Chemical Manufacturers, and Mr J Arthur Reavell, representing the British Chemical Plant Manufacturers Association.

Scientific Progress and Employment

AT the recent annual meeting of the London branch of the Association of Scientific Workers, the chairman, Mr R W Western, read a paper on 'How Scientific Research may best help in the Present World Crisis" Mr Western pointed out that there is a widespread belief that the progress of science tends to create unemployment by substituting machinery for men and replacing highly trained operatives by unskilled labourers Innovations resulting from scientific research are generally found to have injurious secondary effects because (1) land formerly employed in production may be rendered useless, for example, that utilised for a railway is spoilt for other purposes while ferro concrete constructions cost nearly as much to demolish as to erect, (2) fixed capital sunk in superseded processes is rendered obsolete, (3) the number of workers required to produce a given output is reduced, (4) innovations may necessitate costly expenditure on advertisements to get the product known—but the trading community is reluctant to undertake this and prefers to advertise opportunities for gratifying wants already realised These considerations lend support to the view that what is most wanted are new ways of meeting unsatisfied needs by adapting available capital rather than innovations which save labour or supersede capital assets If an innovation founded on the results of scientific research is to produce good results, free from immediate drawbacks and therefore wholly beneficial at the present time, it should render possible the application of idle plant to the commercial utilisation of the waste products of existing processes by employing labour now surplus The best help that scientific research can give in the present crisis will consist in exploring the channels least subject to the drawbacks previously enumerated

Race and Culture in India

IT is not without interest to note that Dr J H Hutton's tentative correlation of race and culture in his Indian Census Report for 1931 not only receives commendatory reference but also is closely followed in method in the presidential address on Sramanism' delivered by Rai Bahadur Ramaprasad Chanda to the Anthropological Section at the recent Bombay meeting of the Indian Science Congress Analysing the concepts of Sramanism, which underlie the doctrine of renunciation, the animating principle of the mendicant and ascetic orders, the president showed that in early times the Vedic religion stressed the rites of the householder and had no place for the Sramanas, the forest dwellers and religious mendicants Hence he deduced that the Sramanas are to be derived from the pre Vedic, pre Aryan peoples and their practitioners of magic tracing the practice of asceticism back to the initiatory period of seclusion and abstinence of the shaman This interesting conclusion, which traces one of the most important elements in modern Hinduism to a non Aryan origin, is supplemented by further considerations bearing on certain of Dr Hutton s ethnological arguments which have been subjected to critical comment Ramaprasad Chanda suggests that the ingrained love of life disclosed by the religions of Saktism and Vaisnavism among the Bengalis, comparable to that found among the Aryans, is a racial psychological trait to be associated with the brachycephalic Bengali castes, the Indo Alpines, of whom Dr Hutton has suggested that they had acquired an Aryan language before they entered India Hence it is suggested, the strength of the Durga Kali cult in Bengal, which only in recent times has begun to give place to the renunciation of sramana

Palæolithic Gravels of Farnham

FOLLOWING the exhibition of Miss Garrod s finds on Mount Carmel a series of flint implements has been arranged at the British Museum to illustrate the sequence of industries in the terrace gravels south of Farnham Surrey Two cases at the head of the main staircase, in the Department of British and Mediæval Antiquities, contain not only a number of accurately located specimens in the Sturge collection as presented by Major A G Wade, but also maps and diagrams showing the terraces of the Wey and the Pleistocene history of the Farnham branch of that river The area has been recently surveyed by the Geological Survey (The Geology of the Country around Aldershot and Guildford, 1929), and Mr Henry Bury s papers in the *Quarterly Journal of the Geological Society* and *Proceedings of the Geologists Association* have been freely drawn on in order to explain the importance of this area for the dating of terrace deposits and the classification of implements It may be eventually possible to identify these four levels with the recognised sequence of terraces in the middle and lower Thames, and the local river captures should explain the presence of some types and the absence of others in the Blackwater and Wey valleys This exhibition will remain open until the middle of July

Recent Acquisitions at the Natural History Museum

IN connexion with the gorilla group to be arranged in the Upper Mammal Gallery, the British Museum (Natural History) has received from Mr Reginald Akroyd a quantity of vegetation collected during a trip which he made for this purpose to the Birunga Mountains, Uganda, last winter This vegetation consists of sections of trees, boughs of giant heaths and giant groundsels, a number of giant lobelias, ferns and tree ferns, and a large quantity of the arboreal lichen which is so characteristic a feature of these mountain forests The Zoological Department has recently received as a donation from the Rowland Ward Trustees a female specimen of a rare howling monkey (*Alouatta ursina*) from Brazil A male, presented by the same donors some years ago, is bright orange red in colour, whereas the female is brown Isolated crystals of native gold from alluvial deposits on the Muti stream, Buhweshu county, Uganda, have been presented to the Department of Minerals by Mr Michael Moses Two minerals new to science have been presented, namely, lusakite a new mineral composed of cobalt and aluminium silicate from 120 miles east of Lusaka, Northern Rhodesia, by Mr A C Skerl, and bismuth tungstate from Cornwall, by Mr E H Davison

THE Department of Botany has received the plants from Capt Kingdon Ward s recent expedition to Tibet The bulk of the collection is from north of Rima, north and south of the great snow range which runs approximately north west to south east In Zayul, south of the range the mountains are well wooded with deciduous and evergreen forest whereas in Nagong, north of the range, there is no forest It was possible to recognise three floral regions in Tibet, and the discovery that the snow range is an eastern extension is of considerable phytogeographical importance About 750 items were obtained and these include some new and interesting plants, and add to our knowledge of the distribution of many others The Department has received by exchange 536 San Thomé and Principe plants from Coimbra Many of them are duplicates of the types of a number of species not previously represented in the Museum collections From Edinburgh 1 423 specimens of *Rhododendron* have been received The majority of the species represented are new to the Museum collections and in many instances are portions of type collections

Palæontographical Society

THE eighty seventh annual meeting of the Palæontographical Society was held in the Geological Society s rooms at Burlington House on April 27, Prof W W Watts in the chair The Council s report recorded with regret the death of the president Dr F A Bather, and of one of the vice presidents, Dr F L Kitchin Since the last annual meeting some arrears of publication have been overtaken by the issue of two volumes of monographs Instalments of the monographs of Corallian Lamellibranchia, Gault Ammonites, Cambrian Trilobites and Dendroid Graptolites are included Another instalment of the monograph of Pleistocene Mammalia deals with the red deer, reindeer and roe Sir Arthur Smith Woodward was elected president, and Mr Henry Woods was elected vice president, Mr Robert S Herries and Dr C J Stubblefield were elected treasurer and secretary respectively The new members of Council are Mr A J Bull, Prof W T Gordon, Dr J Pringle and Mr W P D Stebbing

Natural Conditions of Soil Formation in India

AT the last meeting of the International Society of Soil Science it was decided to prepare a soil map of Asia, and the work of compiling the available materials was entrusted to a sub-commission headed by several of the leading Russian workers This subcommission has already published a number of contributions dealing with the soils of Japan, Manchuria and certain portions of China. A contribution by Dr Z J Schokalsky, published by the Academy of Sciences of the U S S R, Leningrad (1932), covers in a similar way the conditions in India The materials which have been in the hands of the author are so carefully worked out that it is hard to believe that the map has been made by one who has never visited India If it is open to criticism in certain directions this is only because the materials placed before Dr Schokalsky have been unsatisfactory and imperfect It must, however, be recognised that the references cited in the present contribution are far from complete and in a number of cases do not include the best materials available Thus, for example in connexion with the soils of north east India the whole of the admirable work done by the experts of the Indian Tea Association is omitted, though their studies are probably the best that have been done over a large area of Assam and Bengal Again, probably the best information about actual soil conditions and their distribution in peninsular India will be found in the various survey and settlement reports much of which is summarised in the Gazetteers issued more than a generation ago, and these do not appear to have been consulted A very large area in the north-east of the Peninsula, which forms perhaps the largest forest tract still existing in the country, is marked on the map as consisting of steppe soils Even with regard to the black cotton soil, or *regur*, the account given takes no account of the radically different types of the soil in the northern and the southern parts of the black soil area Before the present map is finally issued as an authoritative account of Indian soils, it will have to be subjected to very careful constructive criticism

Landscape Gardening

THE Institute of Landscape Architects is to be congratulated upon the appearance of *Landscape and Garden*, a new quarterly journal devoted to garden design and landscape architecture (vol 1, No 1, 1934, pp 74 2*s* 6*d*) The volume is edited by Mr Richard Sudell The Garden Theatre at the Herrenhausen Hanover, is described briefly by G A Jellicoe who shows by means of plans and photographs the lay-out of this very artistic piece of garden architecture R V Giffard Woolley contributes a helpful study on The Management of Small Spaces" Various considerations for the production of vistas, and the incorporation of stone paving and ornament are given A park to link Karlsruhe with the Rhine is described by P Morton Shand, and particulars of an interesting bird sanctuary are included Capt R C H Jenkinson writes about New Shrubs for Old", and in addition to describing several of the more recently introduced shrubs, discusses possibilities for their artistic grouping Birdseye' is a series of aerial photographs showing forms of community housing in England through the last five hundred years A J Cobb writes on 'Tree Surgery', outlining methods for the lengthening of life, or the complete repair, of damaged trees The use of focal points in design is very ably treated by Hervey Bennett, in an article entitled "Where Shall I Look ?" A series of photographs showing the illumination of gardens, together with a short description, are provided by Waldo Maitland Some very striking effects, produced by flood lighting trees, are shown 'Roof gardens, the Lungs of the Future" are given adequate treatment in an article by Lady Allen of Hurtwood, who introduces many practical suggestions One might advance the suggestion that the extremely small spaces' such as are included with the majority of present day houses might receive adequate treatment in future numbers, though the editor seems to be alive to this need A study of the development of the garden city' is promised for the next number (July)

Research on Oranges and Related Crops

THE British South Africa Co has issued a report on the activities of the Mazoe Citrus Experimental Station up to the end of 1932 (Oxford Univ Press, 192 pp) The Director, Dr W J Hall, and Mr W K Ford are engaged in a study of the citrus insects of Southern Rhodesia, and publish detailed descriptions of a considerable number of pests Soils of the Mazoe Estate are under investigation by Dr A A Morris who contributes a paper on the relation between soils and field practices Special attention has been devoted to irrigation cover crops and manures Problems of artificial coloration, maturity and transport wastage of oranges have engaged the attention of Mr G R Bates The work of the Station is comparatively recent, but the various problems are being studied with a detail which should ensure the production of valuable results

Electrical and Magnetic Units

BULLETIN No 93 of the National Research Council, Washington, reproduces the papers on units presented before the American Section of the International Union of Pure and Applied Physics at Chicago in June last After discussion it was recommended —that in view of the long use of the classical centimetre gram second units, no change should be made at present, but that the Gaussian system should be considered in future, that the practical units—ohm, volt, ampere, coulomb, farad, henry, joule and watt—might be extended into a complete absolute system either through the metre-kilogram-second or the centimetre-10^7 gm -second, the former by preference These proposals will in due course be considered by the Committee on Symbols, Units and Nomenclature established by the International Union

Health of the British Army during 1932

LIEUT GEN H B FAWCUS, director general of the Army Medical Services, states that the health of all ranks throughout 1932 was satisfactory ("Report on the Health of the Army for the Year, 1932" London H M Stationery Office, 1934 2*s* 6*d* net) The admission rate to hospital, 412 5 per 1,000 of the strength, was the lowest on record, and the invaliding and constantly sick rates were also the lowest recorded since the War All the more important diseases have shared in the decline, namely, malaria, dysentery, influenza, tonsillitis, venereal diseases and others In consequence of the high incidence of tonsillitis over many years, a Joint Medical Services Committee has studied the subject, but without reaching any very definite conclusion as to causation or prevention A summary of research work is given in the report

German Exhibition of Chemical Plant

'ACHEMA" is the Ausstellung für chemisches Apparatewesen, the seventh of which is to be held at Cologne on May 18–27 under the auspices of 'Dechema", the Deutsche Gesellschaft für chemisches Apparatewesen In anticipation of this exhibition the Achema Jahrbuch 1931/1934, a report of some 230 pages on the position and development of the study and construction of chemical plant, has recently been published by Dechema at Seelze bei Hannover Those who are interested in the exhibition and apply before May 10 can obtain a copy of the Jahrbuch, which is priced at 10 m , on sending only 0 40 m to cover the cost of postage The "Wissenschaftlicher Teil" includes articles on the development of technique and plant construction, on standards in apparatus, on welding in the building of chemical plant, on instruments for the measurement of therapeutically active ultra violet light emission, and on the Drawinol process for dehydrating ethyl alcohol The Technisch industrieller Teil' contains information concerning constructional materials, laboratory apparatus, technical apparatus, plant and machinery The book serves also as a guide to the exhibits We are reminded that in describing the sixth exhibition held at Frankfurt am Main in 1930 we said that there could never have been a more comprehensive show of aids to chemical manipulation, at Cologne 300 firms will exhibit more than 2,000 types of apparatus and plant, so that the forthcoming exhibition is unlikely to be less valuable and impressive

Congress of History of Medicine

THE International Society of the History of Medicine has received an official invitation from the Spanish Government to hold its tenth congress at Madrid in the second fortnight of September 1935 The following subjects, of which the executive committee has to select two, have been suggested for discussion Spanish colonial medicine, Pre Columbian medicine, the history of syphilis, medical folk lore, and the introduction of biological ideas into the domain of history, a subject proposed by Prof E Jeanselme of Paris This Congress of 1935 must not be confused with that organised by the International Academy of the History of Sciences, which will be held this year at Barcelona, Madrid, Toledo, Coimbra and Lisbon, on September 19–October 2

Television Inquiry

THE Postmaster General stated in the House of Commons on April 30 that he hoped to announce shortly the composition of a committee which will advise on the conditions under which any public television service should be provided It is understood that the Committee to be appointed will consist of representatives of the Post Office, the British Broadcasting Corporation and the Department of Scientific and Industrial Research

Announcements

DR JOSEPH PEARSON, who recently resigned his post as director of the Colombo Museum and marine biologist to the Ceylon Government, has been appointed director of the Tasmanian Museum, Hobart, as from March 1 last

AT the meeting of the London Mathematical Society to be held on May 17 at 5 p m in the rooms of the Royal Astronomical Society, Burlington House, Prof E A Milne, of Oxford, will give a lecture on World Gravitation by Kinematic Methods"

THE Institution of Civil Engineers has awarded a Charles Hawksley Prize of £150 for 1934 to Mr H G Cousins, for his design of an aerodrome The prize is awarded for the best design of an engineering structure combining artistic merit with excellence of constructional design, and the competition is open to students and associate members of the Institution less than thirty years of age

KEDDEY FLETCHER WARR Studentships of the University of London, each of the value of £210 a year for three years, have been awarded to Dr E G Jones, for the continuation of research in spectroscopy, and to Dr A C Offord, for the continuation and extension of research in pure mathematics

THE Frazer Lecture, founded in honour of Sir James Frazer, is delivered annually at the Universities of Oxford, Cambridge, Glasgow and Liverpool in turn, and this year goes to Oxford for the fourth time It will be delivered on May 10 at 5 30 p m in the Examination Schools, Oxford, by Prof H J Rose, of the University of St Andrews, who will take as his subject "Concerning Parallels"

THE Association of Special Libraries and Information Bureaux (ASLIB) will hold its eleventh annual conference at Somerville College, Oxford, during the week end beginning on September 21 Particulars may be obtained from the Secretary of the Association, 16, Russell Square, London, W C 1 Sir Richard Gregory has agreed to accept nomination as president of the Association for 1934–35

THE Rockefeller Medical Fellowships for the academic year 1934–1935 will shortly be awarded by the Medical Research Council, and applications should be lodged with the Council not later than June 1 These Fellowships, of the annual value of £350, are awarded to graduates who have had some training in research work in the primary sciences of medicine, or in clinical medicine or surgery, and are likely to profit by a period of work at a university or other chosen centre in the United States before taking up positions for higher teaching or research in the British Isles Full particulars and forms of application are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S W 1

THE 'Handbook of the Collections Illustrating Electrical Engineering" (Science Museum, South Kensington Part 4) (H M Stationery Office 2s net) gives the substance of the detailed descriptive labels associated with the exhibits in the Electric Power Collections in the Science Museum By means of asterisks, attention is directed to the more important exhibits which have influenced future developments It will be most useful to those who desire to study the historical development of the use of electric power

MESSRS OPPENHEIM AND CO (RARE BOOKS), LTD , 174 Fulham Road, London, S W 10, now in liquidation, have issued a special sale catalogue of journals and periodicals of British and foreign learned societies The list includes long runs and shorter sets of publications on most branches of science, natural history, medicine, engineering and economics Among the more important items is a complete run of the *Annals and Magazine of Natural History*, from the commencement in 1838 to 1927, to be had for the bargain price of £115 This is a low priced list which should appeal especially to librarians

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —An assistant lecturer in metallurgy in the University of Manchester—The Registrar (May 7) An engineer and surveyor to the Brentwood Urban District Council—The Clerk of the Council, Council Offices, Brentwood (May 7) A lecturer in engineering at the Wigan and District Mining and Technical College—The Principal (May 7) An assistant master to teach two of the following subjects machine drawing, mechanics, physics, mathematics, at the Portsmouth Junior Technical School—The Town Clerk, Guildhall, Portsmouth (May 10) A principal of Kilburn Polytechnic—The Secretary, Middlesex Education Offices, 10, Great George Street, Westminster, S W 1 (May 16) An assistant lecturer in physics in the University of Manchester—The Registrar (May 26) A teacher of electrical engineering at Dartford Technical College—The District Secretary, Education Offices, 15, Lowfield Street, Dartford (May 26) A headmaster of the Ashton under Lyne Junior Technical School—G W Handforth, Education Office, 8, Warrington Street, Ashton under Lyne (May 26) An Imperial mycologist at the Imperial Institute of Agricultural Research, Pusa, Bihar and Orissa, India—The High Commissioner for India, General Department, India House, Aldwych, London, W C 2 (May 31) An assistant engineer to the Water and Sewerage Board, Corporate Area of Kingston and St Andrew, Jamaica—The Crown Agents for the Colonies, 4, Millbank, London, S W 1 A woman tutor in mathematics at the Edge Hill Training College, Ormskirk—The Principal

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Magnetic Properties of Supraconductors

I SHOULD like to report the results of experiments which bear on the recent discovery of Meissner and Ochsenfeld, regarding the magnetic properties of matter in the supraconducting state I feel that our results will add something to this original contribution and the further contribution made recently by Mendelssohn and Babbitt[1]

According to Meissner's results if a supraconductor be lowered from a temperature above the transition point to a temperature below that point, with a constant magnetic field applied, we should expect to observe a change in flux in search coils placed in various positions relatively to the supraconductor and the field A supraconducting body in the shape of a hollow cylinder of tin was used, and small coils wound about the tin or placed near the tin, as indicated in Fig 1 Coil No 1 was wound around one side of the cylinder Coil No 2 was placed inside the hollow cylinder Coil No 3 was placed near the surface of the cylinder tangential to the applied field Coil No 4 was wound so as to enclose the whole cylinder in the plane of the coil No 5 was placed at the outer surface of the cylinder perpendicular to the applied magnetic field According to the results reported by Meissner, if one applies a magnetic field when the tin is above its supraconducting point, and leaves this field constant while the temperature of the sample is taken through its transition point to a temperature definitely below the supraconducting temperature, one should observe the following In coil No 1, decrease to zero flux, in coil No 2, no change in flux, in coil No 3, increase of twice the applied field intensity, in coil No 4 decrease in flux due to wiping out of the flux in tin, in coil No 5, decrease to zero flux

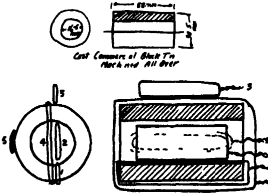

FIG 1

In our experiments these search coils were arranged to be connected directly to a flux meter, and the deflections were read by means of a lamp and scale Our preliminary results, which have been checked two or three times, are as follows As the tin cylinder was taken from above the transition point to below, coil No 1 showed a decrease of 90 per cent in the flux, No 2 showed a slight increase up to 10 per cent, coil No 3 showed an increase of 25 per cent, coil No 4 a decrease of 30 per cent, and coil No 5 a decrease of from 20 to 25 per cent in the flux It should be noted that coil No 3 projected about 5 mm from the surface where there was undoubtedly a magnetic field of high gradient and also that coil No 5 of necessity enclosed a considerable space where the field was not theoretically zero, but only relatively weakened The field strengths used were approximately 30, 150 and 200 gauss respectively Repeated readings were carried out with the stronger field

This work was carried out with the assistance of Mr J O Wilhelm and Mr F G A Tarr

E F BURTON.

McLennan Laboratory,
University of Toronto
April 5

[1] NATURE 133, 459 March 24 1934

Constitution of Hafnium and other Elements

TAKING advantage of the exceptionally favourable setting of the anode discharge tube used in the analysis of the rare earths already reported[1], I have obtained further results of great interest

Hafnium gives a mass spectrum indicating five isotopes, a weak line at 176 and four strong ones, 177, 178, 179, 180, of which the even numbers are rather more abundant Thorium appears to be simple 232, no line of higher mass number could be seen Rhodium gave the feeblest effect of any element yet analysed, only one line, that expected at 103, could be clearly detected

Very intense spectra were obtained from calcium, disclosing faint new isotopes, 42 and 43, in addition to 40 and 44 previously discovered by Dempster It also appears very probable that a line at 41 was partly due to an isotope of calcium, but the difficulty of making an accurate estimate of its intensity and the impossibility of entirely excluding potassium are obstacles still in the way of a definite proof of this interesting conclusion

Numerous attempts to analyse titanium in the past have yielded very inconclusive results Satisfactory mass-spectra have now been obtained which show its main line, 48, flanked by four new faint lines, 46, 47 49, 50, the whole forming a most striking symmetrical group It is noteworthy that with the discovery of these isotopes and that of argon 38 recently reported by Zeeman, all the numbers from 9 to 56 are now filled

New mass spectra obtained from zirconium not only show an additional and fairly abundant isotope 91, hitherto overlooked owing to insufficient resolution, but also confirm the presence of the very rare and previously doubtful constituent 96, which is of particular interest, as it forms with molybdenum and ruthenium the lightest known isobaric triplet

Further work with samarium has disclosed two faint isotopes, 144 and 150

Only four common elements, palladium, iridium, platinum and gold, still remain to be analysed, even with the present setting, all attempts with these have given negative results

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April 21

[1] NATURE, 133, 327 March 3, 1934

Small Angle Scattering of Electrons in Helium

IN July 1933[1] one of us (R W), in collaboration with T Emmerson and J E Taylor, pointed out that, in agreement with Mr S N Van Voorhis[2], we had been obtaining curious scattering effects using narrow electron beams passing through helium at low pressures

The effect, which was very marked at energies of between 100 and 200 electron volts, consisted in a very obvious maximum in the number of inelastically scattered electrons at a few degrees out from the main beam This result was so remarkable and unexpected as to demand further and much closer examination and with that end in view a special apparatus has been set up in this laboratory

Briefly, the electron gun is rotated slowly and continuously by a synchronous electric motor, the scattered electrons after passing through a slit system, being analysed by a magnetic field and the resulting spectrum recorded on a photographic film kept in continuous motion by a second synchronous motor The result is a continuous record of all the scattered electrons both elastic and inelastic over the desired angular range, energy and number being simultaneously recorded in terms of position on the film and photographic density respectively

The photograph here reproduced as Fig 1 indicates the elegant kind of record which can be obtained by this method The two separate spectra show the variation in probability up to 10° from the main beam of elastic impacts, and those which have resulted in the two most likely transitions ($2P$ and $3P$) At the top of the record are to be seen four wavy traces which have been produced by sweeping the electrons (at zero beam setting) rapidly across the film with a time marking device By suitably accelerating the motion, a range of wave lengths can be obtained, as shown, from which density intensity information can be derived for interpreting the spectral traces themselves

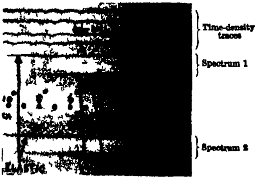

FIG 1

The anomalous results previously reported have not, so far, been confirmed with this more refined apparatus

We have measured the relative probabilities of the elastic and inelastic ($2P$) collisions at angles up to 10° at energies of impact varying between 100 and 400 electron volts with the results shown in Fig 2 Here the inelastic probabilities given by the most recent form of theory (Massey and Mohr)[3] have been taken as the basis and in agreement with our experimental results (full curves marked $2P$) It will be seen how very different are the calculated (full lines) and experimental (dotted lines) values for the elastic probabilities In particular, at the lower impacting energies this divergence is specially remarkable

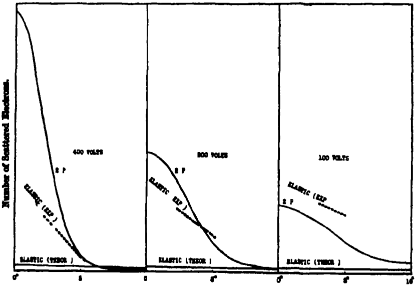

FIG 2

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R WHIDDINGTON

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[1] NATURE 132, 65 July 8 1933
[2] *Phys Rev* May 1 1933
[3] *Proc Roy Soc* A 140 613 1933

Galvanometer Amplification by Photo-Cell

IN 1931[1] I described the use of a differential photo electric cell connected to a secondary galvanometer for amplifying the movements of a primary one The only suitable cell available then was a cuprous oxide one, and the current produced by it was not great enough to allow a quick (and therefore insensitive) secondary galvanometer to be used, consequently, although sufficient amplification was obtained, the movements were slowed This slowing of movements is an even greater objection to the thermal relay of Moll and Burger since the thermocouple introduces a further lag which the photo-cell does not

I have recently tested a Weston 'photronic' cell for the same purpose This cell was opened and a groove cut down the centre of the disc Lead fuse wires were then inserted to make contact with the faces of the two halves These lead wires were joined to terminals by which the cell was connected to a Kipp micro galvanometer of period 0 2 sec With this a five to tenfold amplification can be obtained of a galvanometer of 1 5–5 sec period, without introducing any measurable lag into its movements A Moll galvanometer of 1 25 sec period used in place of the microgalvanometer as a secondary would give a further fourfold multiplication an amplification of at least twenty times It would still introduce little lag into the movements of the primary one

By this means any galvanometer of sufficient steadiness can have its figure of merit increased many times For those who can go to the trouble and expense of using a second galvanometer of short period and a photo cell the problem of sensitive galvanometers is reduced largely to one of steadiness and zero stability, given those amplification with a photo cell can supply the required sensitivity—to the limit of course set by Brownian movements of the primary galvanometer

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[1] *J Sci Instr* 8 26.

Diffraction of Cathode Beam by Simultaneous Reflection from two Different Specimens

FROM the first investigations of G P Thomson[1] dealing with the structure of surface layers up to the present time the method of using a specimen ground flat has remained apparently without change[2] though the construction of a crystal holder for this method is comparatively complicated and the results obtained in such a way cannot apparently be of high degree of accuracy The investigation of the surface structure by reflection is, however, of great interest We have recently succeeded in obtaining very exact results by means of a simultaneous reflection of a cathode beam from two specimens, one of them was a substance the lattice constants of which were very exactly known, such as sodium chloride

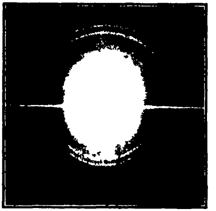

FIG 1

As has been shown by H de Laszlo and V Cosslet[3] the cathode beam is hollow The results of our study confirm this Therefore for obtaining a sharply outlined diffraction pattern it is evidently not necessary to use the entire cross section of the cathode beam, but only one side of it, and this can be done only with a convex specimen From Fig 1 it can be seen that this method not only gives a sharp diffraction pattern, but also simultaneously a very sharp spot from the cathode beam may appear in the photographic plate, so that the centre of the rings can be found at once If a cathode beam is passing between two such convex specimens (Fig 2) a double diffraction pattern appears as is shown (Fig 1)

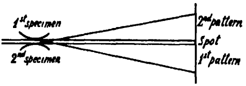

FIG 2

When compared with the method of taking successive photographs one after the other[4] we believe our method has the advantage that the possible change of high voltages is with simultaneous exposures of no importance Moreover the mounting of such a double specimen and its setting in the beam is exceedingly simple

A fuller account of this method will be published shortly

N A SHISHACOW
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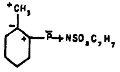
March 9

[1] G P Thomson, *Proc Roy Soc* A 128 641 649 1930
[2] See for example J Cates *Trans Farad Soc* 29 817, 1933 G D Preston *Phil Mag* 17 466 1934 R O Jenkins *Phil Mag* 17 457 1934 A G Emsll *Phys Rev* 45 43 1934
[3] NATURE 130 59 July 9 1932
[4] G I Finch and A G Quarrel NATURE 131 842 June 10 1933

The Polarity of the Co-ordinate Link

IT has already been shown[1] that organic sulphides and tertiary arsines differ markedly in their reaction with chloramine T The former give rise to sulphilimines of formula $R_2S \rightarrow NSO_2C_7H_7$, in which the co ordinate link is apparently devoid of polar properties the arsines however, do not give stable arsinimines of formula $R_3As \rightarrow NSO_2C_7H_7$ because the co ordinate link in such compounds apparently possesses sufficient polarity to combine with water, producing thus the corresponding hydroxy sulphonamides, $R_3As(OH)\,NHSO_2C_7H_7$ This behaviour is similar to that of the tertiary arsine oxides, $R_3\overset{+}{As} \rightarrow \overset{-}{O}$ where the strongly polar link induces ready combination with water to give the dihydroxides $R_3As(OH)_2$

We are undertaking a systematic study of the action of chloramine T on the organic derivatives of the elements of Groups 5 and 6 and the tertiary phosphines in this respect come midway between the sulphides and the arsines, the final product depending primarily on the nature of the tertiary phosphine Thus tri *o* tolylphosphine gives a true phosphinimine, $(C_7H_7)_3P \rightarrow NSO_2C_7H_7$, (*A*), and no other product has been detected tri-*p* tolylphosphine gives a mixture of the phosphinimine isomeric with (*A*) and the corresponding hydroxy sulphon amide, $(C_7H_7)_3P(OH)\,NHSO_2C_7H_7$, (*B*) Tri *m* tolyl phosphine apparently gives no phosphinimine, the only product isolated being the hydroxysulphonamide isomeric with (*B*)



These results are apparently determined chiefly by the position of the methyl group relative to the phosphorus atom. The co ordinate link in (*A*) will tend to give the P and N atoms a weak positive and negative charge respectively, $(C_7H_7)_3\overset{+}{P} \rightarrow \overset{-}{N}SO_2C_7H_7$, simultaneously, however, the polarity induced by the three *o* methyl groups will tend to give the *P* atom a negative charge The polarity of the co ordinate link is thus suppressed and a stable phosphinimine results In the *p* compound, the effect of the methyl groups is similar but, owing to the greater distance involved, definitely weaker hence the formation of both the phosphinimine and the hydroxysulphon amide In the *m* compound however, the polarity induced by the methyl groups reinforces that of the co ordinate link, and therefore, as with the arsines, the hydroxysulphonamide alone results

This interpretation of our results obviously requires considerable further confirmation, which we are now seeking with aromatic phosphines containing other electropositive or electronegative groups mean while, aliphatic phosphines apparently all give stable phosphinimines We are also attempting to prepare a dissymmetric phosphinimine, $R_1R_2R_3P \rightarrow NSO_2C_7H_7$, in which R_1 contains an acidic or basic group for salt formation since such a compound should clearly be capable of resolution into optically active forms

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F G **MANN**

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March 29

[1] Mann *J Chem Soc* 958 1932

Multiple Laue Spots from Aluminium Crystals

INVESTIGATING the distribution of the intensity along the Laue spots from thick (6 mm) deformed aluminium crystals, we have found that it depends strongly upon the degree of the plastic deformation The spots from a thick undeformed crystal are elongated radially and uniformly black (Fig 1) Each portion of the spot is formed by rays reflected from a corresponding region of the crystal along the beam The spots from the same crystal only slightly plastically deformed (0 5 per cent) are no longer uniformly black (Fig 2) The blackening increases on the ends of all spots and also in the inner parts of several spots The spots become double or triple and similar to the multiple spots which have been described in other investigations[1] This result indicates that the exterior layers, and certain layers situated inside, scatter more energy and therefore are more imperfect than other layers We conclude that the degree of the plastic deformation and, therefore, the distribution of the residual stresses along the path of the beam are not uniform The dependence of the doubling on the distance from the crystal to the photographic plate is an indication of the focusing property of the differently oriented blocks, situated along the path of the beam (the beam was one of small divergence) It seems that multiple Laue spots which have been described in previous investigations[1] may be due to the reversible or irreversible changes of the perfection of the crystals and also to the focusing in the case of the deformed crystals

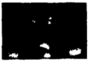

FIG 1 Laue spots from an undeformed crystal

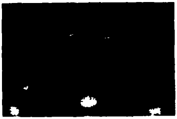

FIG 2 Laue spots from a deformed crystal

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March 9

[1] Y Sakisaka and I Sumoto *Proc Phys Math Soc Japan* (3) 13 211 1931 C S Barrett *Phys Rev* 38 832 1931 J S Cork *Phys Rev* 40 749 1932

Height of the Aurora in Canada

DURING the winter of 1932 33, a number of measurements of the height of the aurora borealis were made at Saskatoon (lat 52 07′ 53″ N , long 106° 37 47″ W) It was found that the height at which the lower limits of the auroral arcs and bands were most frequently seen was 105 km , a value in close agreement with that found by Størmer and others in Norway Fig 1 shows the distribution curve, the number of auroral points measured being plotted against their height in kilometres In plotting this curve, 220 points were used and they were taken in 5 km groups

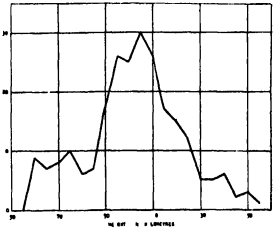

FIG 1

Størmer[1] has stated that the lower limit of height observed in Norway is 80 km In connexion with this, our observations of April 16 and April 20, 1933, are particularly interesting On these two occasions bands were photographed the lower limits of which were at a height of only 60 km Thirty seven measurements were made on auroral features the heights of which were less than 80 km, and eighteen of these showed heights of less than 70 km, the lowest recorded being 59 km In these photographs the intensity was good and the edge of the aurora clearly defined The calculations were made by the network chart' method of Harang and Tonsberg[2], and the direction of the displacement of the aurora relative to the fixed stars was quite favourable The length of the base line used for the photographs was 112 km

In addition to the results described above, several measurements were made on long ray structures in the aurora One of these was found to extend from a height of 336 km at its upper limit to a height of 71 km at its base, while a second extended from 155 km to 74 km It therefore appears that, in Western Canada, the lower limit of the auroral displays is nearer to the earth s surface than in Norway

These results will be published in detail later as part of the Canadian contribution to the International Polar Year work

T Alty
F J Wilson

University of Saskatchewan,
Saskatoon, Saskatchewan
March 10

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[1] Størmer Photographic Atlas of Auroral Forms Supplement 1 p 8

[2] Harang and Tonsberg Investigations of the Aurora Borealis at Nordlys Observatoriet Tromso *Geofys Pub* 9 No 5 1932

Meteorology of a Gliding Flight

As meteorologists have shown a certain amount of interest in the experience of glider pilots, the following brief account of my flight from Dunstable to Rayleigh in Essex, on April 22 may be worth recording

The flight was made in a high performance sailplane the Rhönadler 32, hand launched from Dunstable Downs, which at this point rise some 200 ft above the surrounding country and about 850 ft above sea level The wind direction was approximately due west and velocity about 8 m p h At 10 30 a m cumulus clouds formed rapidly, and on taking off at noon the sky was three quarters covered with this type The instruments carried were a barograph, an altimeter, air speed indicator, variometer and compass

After slope soaring for a few minutes at a height of only 100 ft I detected the rising current under a small cumulus and promptly circled in the manner of the convection soaring birds The machine rose steadily some 2,000 ft, when I decided to fly up wind under a much larger cloud which appeared to be in the process of formation This decision proved very beneficial, as only a few hundred feet were lost in the journey, and height was very rapidly regained under the cloud At 3,500 ft I entered the cloud base and thus commenced my first cloud flight with neither parachute nor appropriate instruments—a distinctly stirring experience The rising current inside the cloud was considerably more violent than underneath it, so much so that one felt definitely forced into the seat Unfortunately, my variometer, an experimental type, was not working very well so I cannot say what was the maximum rate of climb I emerged from the side of the cloud at approximately 5,000 ft above the start in brilliant sunshine and steered in a south easterly direction, finally landing near Southend, an approximate distance of 54 miles from the start

The flight could undoubtedly have been prolonged but for the fact that London's smoke caused a thick haze, and the cloud form degenerated into a stratiform type with only a weak rising current

The lowest altitude recorded was 1,200 ft, but circling under and into a cloud again restored me to 5,000 ft

Perhaps meteorologists could tell us if a sensitive thermometer would be useful in detecting rising air and also indicate, generally, how sailplane pilots can assist the science of meteorology

G E Collins

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Dunstable,
Beds

Field Studies and Physiology: a Further Correlation

In a previous letter to Nature[1] one of us directed attention to certain striking correlations between the findings independently arrived at by physiologists in the laboratory and students of bird behaviour in the field Since then a further parallelism has come to light which it seems of sufficient interest to record Wiesner and Sheard[2] state that partial removal of the prepituitary in adult male rats usually results in what they style partial diserotisation' The normal copulatory process consists in a definite and rapid sequence of acts In partially hypophysectomised males, the sequence is usually slowed down and interrupted, consisting merely of hesitant acts of mounting, often abortively repeated many times

Observations on moorhens (*Gallinula chloropus*) show that behaviour of a similar nature is often encountered in the wild state Here too the normal male mating process consists of a sequence of actions usually performed very rapidly so as to appear like a unitary act During cold disagreeable weather, however, the sequence is often much slowed down, and interrupted in the middle For example, after mounting on the female's back, the male may appear confused, and after an interval of hesitation descend without proceeding further Or the sequence may be interrupted earlier, for example, after the male has merely placed a foot on the female's back A curious fact is that such incomplete sex behaviour usually ends in the male viciously pecking the female

Such behaviour is to be observed in the same birds which on previous fine days had been mating normally The cold appears to act more or less quantitatively, very cold weather entirely extinguishing all sexual behaviour, moderate cold inducing only slight 'diserotisation' Poultry keepers are familiar with similar effects of cold weather on cocks

Pavlov[3] has observed similar phenomena in non sexual reactions in his experimental dogs, both as regards the dissociation of acts normally associated, and in the slowing down and the meaningless repetition of acts In addition, 'negativism', a negative reaction to a stimulus which usually induces a positive reaction, is often seen this may be compared with the male moorhen's incomplete sexual behaviour terminating in an attack on the female Pavlov speaks of these phenomena as hypnotic, and ascribes them to special types of spread of inhibition in the cortex

We *have thus similar modifications of normal* action due in one case to glandular deficiency in another to depressant external conditions and in a third to psychological causes Further investigation of such phenomena, whether in the field or the laboratory, should be of great interest for the science of animal behaviour

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and Clareland Stourport
April 12

[1] NATURE 129, 166 Jan 30 1932
[2] NATURE 132, 641 Oct. 21 1933
[3] *Character and Personality* 2, 189 1934

Rings of Cork in the Wood of Herbaceous Perennials

APPARENTLY the only plants reported to have successive rings of true cork in the wood are certain species of *Sedum*[1,2] There are, however, the closely related cases of *Gentiana cruciata*, *Aconitum Lycoctonum*, *Salvia* spp[3], *Delphinium* spp[4,5] and *Mertensia* spp[6], in which cork develops to some extent in the xylem but is rarely found there in the form of concentric layers In these plants, as also in *Sedum* spp internal cork is said to arise in connexion with the splitting of the rhizome or root into strands and the segregation of vascular bundles directly connected with effete leaves and annual shoots There are also on record[7] examples of localised and anomalous cork layers round groups of vessels in the wood of various species Finally there is the case recently described by Lemesle[8] of concentric suberised layers in the wood of *Hymenocrater* spp , but here, no cork cambium is formed and the suberised layer is properly described by Lemesle as a pseudoperiderm

My discovery of concentric rings of periderm as a constant feature, in the wood of older subterranean organs of several herbaceous perennials, namely *Epilobium angustifolium*, L *E latifolium* L *Gaura coccinea* Nutt and *Artemisia dracunculoides*, Pursh is therefore of interest In the first of these species the horizontal roots, likewise the underground stumps' of former aerial stems, may live for many years, and each year may send up flowering shoots As many as twenty concentric rings of periderm have been observed in the wood of old roots, while numbers ranging from one to ten have been commonly encountered The wood of this species includes not only vessels and fibres but also a large proportion of phloem and parenchymatous elements Each summer a zone of periderm arises in the parenchymatous part of the wood formed near the close of the previous summer, or less frequently in a more deep seated position in the wood When mature this interxylary periderm commonly consists of two or three layers of cork cells with alternating layers of non-suberised cells

The point of chief interest here is the development of interxylary periderms in relation to the dying down of flowering shoots and the origin of new annual shoots Each new interxylary periderm arises in June, between the wood that served last year's aerial stem and the thin sheet of new wood connecting with the young shoots Above the point of insertion of the uppermost of the new shoots, very little, if any new xylem develops, and in that region this internal periderm makes connexion across the phloem with an external periderm Furthermore, the interxylary periderm extends as a continuous layer *throughout the entire subterranean system* with the exception of the younger roots As a consequence, the various tissues in direct connexion with the new shoots are segregated by a barrier of cork from necrotic tissues as well as from the older wood The younger parts fitting in sleeve like fashion over the older decadent cylinder are therefore protected against possible desiccation and invasion of destructive organisms For as the stump of a floral shoot disorganises a broad hollow path bordered mainly by soft tissues becomes exposed to various external agencies Thus *the interxylary periderm* may function in somewhat the same way as does suberised tissue below the abscission layer of a leaf Persistence of plants in particular locations may be largely due to the protection afforded by this internal suberised barrier

In both species of *Epilobium* and in *Gaura coccinea*, fission of older roots into strands commonly occurs This phenomenon is related to the occurrence of concentric rings of interxylary cork and to the mode of production and dying back of shoots and of rootlets Nevertheless fission in these species differs in certain important respects from all previously described examples[2,3,4,5,6] of this phenomenon

The discovery of interxylary cork reported here raises questions regarding the general occurrence and the significance of the internal suberised barrier as well as questions concerning the physiology and ecology of perennating herbs devoid of this structural feature I would welcome references to literature and comments bearing upon these problems Detailed descriptions of the subterranean organs of the species in hand are now being prepared for publication

E H MOSS

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March 14

[1] Solereder H *Systematic Anatomy of the Dicotyledons* Oxford, 323 1908
[2] Jost, L., *Bot Z* , 48 503–512 1890
[3] *ibid* 483 485, 501
[4] Kingsley, M. A *Bull Torrey Bot Club* 38, 307–318 1911
[5] Pfeiffer, H Linsbauers Handb der Pflanzenanatomie Bd 9 191 , 1928
[6] Skutch A F , *Ann New York Acad Sci* , 32, 1–52 1930
[7] Lemesle R *Bull Soc Bot France*, 75, 272 , 1928
[8] Lemesle R *C R Acad Sci* 186 455 1928

The Neutrino

ALTHOUGH it seems very unlikely that neutrinos, after having been emitted in a nuclear process, give rise to any detectable ionisation[1], we would like to point out that it is not impossible in principle to decide experimentally whether they exist

One possible experiment would be to check the energy balance for the artificial β decay Take, for example, the process

$$B^{10} + \alpha \rightarrow N^{13} + \text{neutron}$$
$$N^{13} \rightarrow C^{13} + e^{+} + \text{neutrino}$$

One can safely assume that if the positive electron is emitted with the greatest possible energy, the kinetic energy of the neutrino will just be zero The balance of energy in this case will therefore determine the mass of the neutrino For this purpose one would have to know the mass defects of B^{10}, C^{13} and the neutron* the kinetic energy of the α particles and the neutrons and the upper limit of the spectrum of the emitted positive electrons

A second way of deciding the question would be to observe the recoil of the nucleus in β decay With natural β rays this is in practice impossible because the recoil energy is too small but the nuclei involved in artificial β decay are much lighter The kinetic energy of recoil of a disintegrating N^{13} nucleus would be of the order of some hundreds of volts if there were no neutrinos If the neutrino hypothesis is correct there would be a defect of momentum which would be uniquely connected with the lack of observable energy in each individual process

In addition to the nuclear processes mentioned in our previous communication it may also be expected that a nucleus catches one of its orbital electrons decreases by one in atomic number and emits a neutrino (A corresponding process with increase in atomic number is not possible because of the absence of positive electrons) This process further limits the possible mass differences between stable neighbouring isobares and particularly between neutron and proton If the hydrogen atom is to be stable we must have (for the masses)

$$\text{Proton} + \text{electron} < \text{neutron} + \text{neutrino}$$

The probability of such a process is less than that of a process involving emission only the energy of the neutrino being the same The reason is that the momentum of the electron which enters in the third power is about a hundred times smaller But even for a surplus energy of 10^{5} volts the life period of hydrogen would be only 10^{18} years which seems incompatible with experimental facts If therefore the neutrino is not heavier than the electron the neutron must be at least as heavy as the proton

H BETHE
R PEIERLS

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April 1

* The accuracy with which the mass of the neutron can be determined at present is, however far from being sufficient for this purpose H Bethe and R Peierls NATURE 133 532 April 7 1934

Optical Constants of Alkali Metals

A NUMBER of recent researches[1] have shown that electrons in some metals—in the first place in alkali metals—can be considered with sufficient approximation as free The transparency of alkali metals in the ultra violet region discovered by Wood[2] has been recently explained by Zener[3] from the point of view of free electrons Immediately after the publication of Zener s communication we calculated the optical constants n and k of the alkali metals using the free electron gas model and taking into account the collisions of the electrons with the atomic lattice and we obtained satisfactory agreement with the measured values

Kronig in a recent letter[4] states that the calculation of the optical constants of alkali metals can be carried out with the help of the formulæ of his dispersion theory in metallic conductors if one takes into consideration only the free electrons In connexion with this it is interesting to note that our calculations based on the simple Sommerfeld theory of metals give the same results as can be inferred from the comparison of our results with the numerical values published by Kronig Our calculations have been made taking into account (1) the motion of free electrons under the influence of the variable external field (2) the collisions which stop this motion The average velocity of electrons was calculated in just the same way as in the Lorentz theory of the collision damping With this average velocity the current is obtained which is substituted in Maxwell s equations The complex dielectric constant is given by the final formula

$$\varepsilon = 1 - \frac{\omega_0^2}{\omega^2}\,\frac{(\omega\tau)^2}{1+(\omega\tau)^2} + i\,\frac{\omega_0^2}{\omega^2}\,\frac{\omega\tau}{1+(\omega\tau)^2}$$

where $\omega_0^2 = 4\pi N e^2/m$ and τ is the time between two successive collisions of the free electron with the lattice calculated according to the Sommerfeld formula from the specific conductivity The formula contains two parameters which are determined by non optical measurements (1) the specific conductivity σ (2) the number of electrons N per

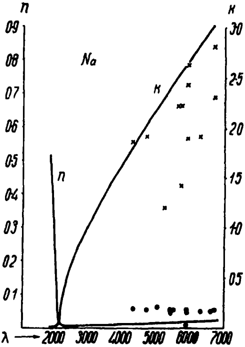

FIG 1

cm³ Putting $\varepsilon = (n - ik)^2$ we obtain n and k represented for the case of sodium by the curves in Fig 1 Dots and crosses denote the measured values[5] n and k

The scattering of experimental values is very large which is explained by the low accuracy of measurements due to the difficulty of preparing a clean metallic surface For potassium the agreement with regard to n in the region of small values is somewhat worse but the order of magnitude remains the same The values of k in this case came out better than for sodium When $\omega\tau < 1$ our formulæ go over into the classical expressions of Drude

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March 13

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[1] O Bryan and Skinner *Phys Rev* 44, 602 1933
[2] Wood *Phys Rev*, 44, 353, 1933
[3] Zener, NATURE 132, 968, Dec. 23, 1933
[4] Kronig, NATURE, 133, 211 Feb 10 1934
[5] Landolt-Börnstein 'Phys Chem Tab

Research Items

Pathology and Deformation in Ancient Egypt. A theory to account for the peculiarities of the human body as depicted in the art of Amarna recently put forward by Herr Felix Proskauer is discussed by Dr. Edith M. Guest in *Ancient Egypt and the East*, 1933, Pts. 3, 4. The theory in question suggests that rickets was widespread in Egypt from the time of the Heliopolitan priesthood, who derived their influence from the discovery of the healing powers of the sun, this also explaining Akhenaton's devotion to sun worship. As against this theory, it is pointed out that neither was the anti-rachitic vitamin D likely to have been deficient in the food of the ancient Egyptians nor were the conditions of their life such that they would have suffered from a deficiency of sunlight owing to avoidance of excessive heat. The dwarfism, of which there are representations in Egyptian art, is not rachitic but achondroplastic. Five, and probably all six, of the representations of dwarfs at Amarna exhibit the inward turning feet due to talipes, which is of a pathological origin quite different to rickets. Turning to the evidence of osteology, among the thousands of skulls which have been examined, there is no evidence of rickets. It is suggested that the peculiar head form of the royal family is an inheritance of hyperdolichocephaly due to a deformation of the pelvis; but there is no evidence to support the view that hereditary dolichocephaly could be produced in this way, or that a flat pelvis prevailed at any time in Egypt. The figures given by Dr. G. M. Morant from early predynastic to Roman times show no evidence for any progressive rachitic dolichocephaly. Although owing to the destructibility of the pelvis the evidence is not exhaustive, no flat pelvis has been recorded. The exaggerated female waist found in certain of the Amarna figures is probably due to a ritual dress.

Seasonal Festivals in Sumeria, Persia and India. In the *Indian Antiquary* for December, Dr. B. C. Mazumdar institutes a comparison between two Hindu social customs and the Babylonian and Persian Sacæa with the view of illustrating the historical significance of the former. Of these, one is a very ancient custom obtaining in the Chauhân ruling houses of Sonpur and Patna in western Orissa, the object of which is to give a fresh lease of life to the ruler in a magical way. In the bright fortnight of the lunar month of Âśvin, a Brahmin goes out riding on a pony, declaring that he has become ruler of the territory. He returns to the palace to doff his authority in a ceremonial at the close of which the rajah takes his place. It is to be noted that the Sumerians began their year in the autumn, just as in ancient India, where the carnival of the 'Lord of Misrule' took place. In this festival a pseudo-king was set up during the five or six days of the carnival, and on the final day he was hanged or scourged. At a later period, in Babylonia and Assyria the New Year was transferred to the spring; but the old calculation was retained and there were thus two New Year festivals, the custom also passing into Persia. The Persian festival shows a close resemblance to the Hindu *Holi* festival. In the Sacæa festival a bogus king rode naked through the crowd, over whom reddened water carried in pots was bespattered. In some of the villages of Bengal the practice still survives of dressing up a fool in a funny fashion and carrying him on a litter through the streets, while the crowd sing obscene songs and sprinkle one another with reddened water. The fool is called King of the *Holi* festival. In many districts an earthen *mañca* is erected with three graduated floors, on the topmost of which an idol of the presiding deity is seated for purposes of worship. This structure bears a close resemblance to the ziggurat. The *Holi* festival, it is noted, does not appear in the Vedic literature, and is evidently a feast of the people.

Transport of Tetanus Toxin to the Central Nervous System. Tetanus or 'lock jaw' is caused by the action of tetanus toxin upon the brain and spinal cord. A wound becomes infected with the tetanus bacillus, which there forms its poison or toxin, and when the toxin reaches the central nervous system, the spasms and convulsions characteristic of the disease result. In the past it has been held that the toxin is not conveyed by the blood or lymph, but by the nerves themselves, either by the nerve fibrils, by the neural lymphatics or by the nerve tissue spaces according to different hypotheses. These views are not accepted by Prof. John Abel in his presidential address to the American Association meeting at Boston in December last (*Science*, 79, 1934, pp. 63 and 121). He points out that there is no valid evidence that nerve fibrils convey toxin. Experiments with convulsant dye-stuffs show that these reach the brain by way of the circulating blood. As regards the neural lymphatics, recent anatomical studies show that these do not discharge into the cerebro-spinal fluid, but into the lymph glands of the general lymphatic system; nor does it seem possible that the tissue spaces of the nerves are capable of conducting the toxin. Prof. Abel concludes, therefore, that tetanus toxin reaches the central nervous system by the circulating blood. He also finds that, contrary to the old ideas, after an injection of toxin, the toxin does not quickly disappear, but considerable amounts persist in the blood and lymph up to the time of the death of the animal.

Crabs in Corals. The crab genus *Cryptochirus* consists of small crabs occupying pits in heads of living coral. There is no means of boring into the coral skeleton, therefore the pit is produced by the growth of the coral about the crab, which when young settles down in a calicle, causes the death of the polyp therein, and remains more or less passive while the living material is gradually laid down about it by the activity of the surrounding coral polyps. Dr. C. H. Edmondson (‘*Cryptochirus* of the Central Pacific”, *Bernice P. Bishop Museum, Occasional Papers*, 10, No. 5, 1933) describes four new species and gives notes on two others. One of these new species, *C. minutus*, is shown to have a peculiar zoea which has a close resemblance to that of *Haplocarcinus marsupialis*, Stimpson, inhabiting galls on many species of corals, an interesting fact which helps to clear up the question of the affinity of the two genera, about which there has been some discussion. *C. minutus* is a small species, the female with carapace only 3 mm. long, inhabiting pits in *Cyphastrea ocellina* and *Leptastrea purpurea*. Some of the pits concealing the females reach a depth of 12 mm. and many are curved or angular in their course. The males, about 1.5 mm. long, do not inhabit the pits with the females, but are found on the surface of the coral in shallow depressions or in a calicle in which the coral polyp has been destroyed

Systematic Position of Stromatoporoids In a paper on *Gypsina plana* and on the systematic position of the Stromatoporoids (*Quart J Micro Sci*, 76, Pt 3, Jan 1934) Prof S J Hickson states that the study of the collection of large specimens of this species made by Prof J Stanley Gardiner in the Indian Ocean suggested to him there was some relationship between these large Foraminifera and the ancient Stromatoporoids Recent investigation of specimens collected by Dr Crossland in Tahiti has confirmed his opinion and he has now no doubt that the Stromatoporoids were Foraminifera, a view that was held last century by W B Carpenter and others All the specimens from the Pacific and Indian Oceans, the Red Sea and the West Indies belong to the same variable species and thus may lead to a reconsideration of the validity of the specific distinction of many other sedentary Foraminifera Two small examples of *Gypsina* are described, they are thin flat discs, 0 6 and 0 9 mm in diameter respectively, and each exhibits a central chamber surrounded by a spiral of five or six chambers, and a thin crust of thin walled acervuline chambers It is suggested these may possibly be the microspheric forms, the large encrusting examples being the megalospheric forms A detailed description of the encrusting forms is given The systematic position of the Stromatoporoidea is fully discussed and the author points out that if the current view is maintained that the fossil forms referred to the Stromatoporoidea were Hydrozoa, then it follows that the Hydrozoa were in existence in Early Palæozoic times, but if as the author concludes they were allied to recent Foraminifera, then there is no clear evidence of the existence of Hydrozoa earlier than late tertiary times

Classification of the Poppy The cultivated poppy and the sesame have been the subjects of detailed investigations by the Institute of Plant Industry, U S S R In The Poppy (Supplement 56, *Bull App Bot*, *Gen and Plant Breeding* 1933, Institute of Plant Industry, Leningrad), Vesselovskaya offers a new classification of *Papaver somniferum*, L based on geographical and ecological principles The author also gives an interesting historical survey of the cultivation of the crop for both oil and opium, this, together with linguistic evidence, is used to support his hypothesis about the origin of the cultivated poppy The investigation is based on a collection of 1,600 samples of seed from various parts of Europe and Asia, all of which were sown in different stations in the U S S R The species falls into a series of seven individual geographical races, formed under the special climatic features of certain areas The parallelism of ecological types of the cultivated and dehiscent poppy indicate that the biological differences of form within the species are due to the prolonged action of various climatic conditions which occur over its area of distribution, stretching from the Atlantic to the Pacific, and from lat 61° N to India The author differs from Basilevskaya in attaching no value to the open or closed condition of the capsule for classification purposes, and in dividing the sub species into a greater number of varieties according to the colour of the flowers and the shape of capsule

Antirrhinum Rust Snapdragons have recently been observed to suffer from a rather severe rust disease Mr D E Green, mycologist to the Royal Horticultural Society, first noticed the trouble in the early summer of 1933, and has since found that many gardens are infected (Antirrhinum Rust, a Disease new to Great Britain, caused by the Fungus *Puccinia antirrhini*, Diet & Holw ' *J Roy Hort Soc*, 59, 119 Feb 1934) Symptoms of the disease are described—brown coloured pustules on the under sides of leaves—and the fungus is shown to produce uredospores and teleutospores The latter can germinate to form basidiospores but these cannot apparently infect snapdragon plants and no alternative host is yet known It is suggested that the fungus persists on plants kept through the winter, and produces uredospores when conditions are suitable Control has been effected in Canada and America by dusting infected plants with flowers of sulphur, whilst the temperature is maintained over 72° F at least twelve hours a day for three days

√**Protection of Stored Rice** According to a Mail Report issued by Science Service Washington D C a new method of protecting rice stored in bulk from insect attack has been tested by Dr E R de Ong consulting entomologist of the city of San Francisco Weevil injury to stored stocks of rice becomes very severe when the stores have to be carried through the summer until the late fall If unchecked, it may result finally in an almost complete destruction of the rice It has been found that coating rice with finely powdered calcium carbonate has given encouraging results under experimental conditions In a jar of uncoated rice, living rice weevils and bran bugs were introduced A similar number of these creatures were likewise placed in another jar to which one per cent of calcium carbonate had been added At the end of the year following the hot summer weather, the number of weevils in the coated rice remained stationary, that is, there had only been sufficient breeding to equal those which died In the uncoated rice the weevils had increased by more than one thousand per cent The weevil attack in the uncoated rice resulted in a loss in weight of 42 per cent—a cubic foot of the coated rice weighed 76 pounds, and the uncoated rice 44 pounds

Jurassic Cephalopods of Kachh (Cutch) The ' Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch) by Dr L F Spath, which has been in course of publication since 1927, has now been completed (*Palæont Indica*, N S, 9, Mem 2, part 5, 1931, pp 551–658, pls 103–124, part 6, 1933, pp 659–945, pls 125–130) Although nominally a revision of the work of Waagen (1875) it deals with a vast amount of new material The author has examined more than 6,600 specimens, in which he recognises 23 species of belemnites, 12 of nautili and 521 of ammonites The deposits, which have an estimated thickness of more than 6,000 ft, range in age from Bathonian to Tithonian and show a general agreement with the stratigraphical succession in Europe The systematic part of the monograph, dealing with 556 species, may appal the stratigraphical geologist, but he will read with interest the concluding chapters on the analysis of the fauna, the palæontological conclusions, and the comparison of the fauna with those of similar age in all parts of the world The author rejects Buckman's view of the universal distribution of ammonite zones since, at the present day, no group of marine animals shows a world wide range, and moreover in the Kachh fauna at least 400 out of the 556 species are to be regarded as local in their distribution Waagen noticed the identity or resemblance of some species to those found in Europe especially in the Mediterranean region Further work, however, has considerably reduced the percentage of the species common to the two regions Unlike many palaeontologists, Dr Spath, after a prolonged and extensive study of ammonites, has come to the conclusion that the evidence of ontogeny is of very little value as an indication of phylogeny and may be altogether misleading Similarly, current views on orthogenesis find no favour in his eyes We also read (p 837) that faunal identity in different areas 'may indicate anything but contemporaneity" A summary of Spath's views on the evolution of the Cephalopoda has been given elsewhere (*Biol Rev* 7, 4, 418 1933)

A New Test for Large Mirrors In the April number of the *Observatory* appears a report of the meeting of the Royal Astronomical Society at which Prof Zernicke propounded the wave theory of Foucault's test and a new method of testing optical surfaces and Mr Burch described the practical application of Zernicke's method The method is extremely powerful, and errors in a mirror surface of the order of a tenth of a wave length of light show up very clearly An advantage of the new method is that the high and low areas of the imperfectly shaped mirror appear in different colours and it is much easier to decide which is a high and which a low area and polish accordingly It is impossible to do justice to the method in a few words, but briefly, it consists in illuminating the mirror with a pin hole source, and examining the image of this source through a tiny disc which retards the phase of the light by a fraction of a wave length Mr Burch makes these phase discs by pouring an acetone solution of resin into water and collecting the globules of resin which are precipitated These are then pressed into small discs between microscope slides The smallest discs are about 1/400 mm in diameter

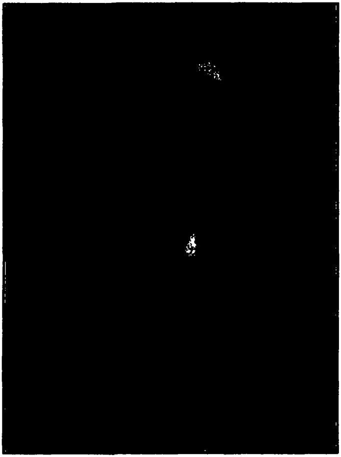
Copper Oxide Rectifiers in Ammeters and Voltmeters For the measurement of small alternating currents and voltages, the copper oxide rectifier used in conjunction with a moving coil instrument possesses far greater sensitivity than any other arrangement It is probable that this combination will be used extensively in the future Hence the paper read by Dr E Hughes to the Institution of Electrical Engineers on March 2 on the accuracy of these combinations is a timely one His tests show that the introduction of a rectifier into a circuit distorts the current wave and causes a rectifier-ammeter calibrated as usual with a sine wave to read low When used in conjunction with a current transformer, it is shown that the ratio of the primary to the secondary current may be rendered practically independent of the current frequency and wave form in two different ways One of these is simply to design the transformer so that the secondary winding has a very large self inductance A paper was also read by R S J Spilsbury in which he describes an instrument incorporating a copper oxide rectifier which gives the form factor of an alternating current wave by a direct reading The form factor, that is, the ratio of the effective value of a wave to its mean value, is of importance in several branches of electrotechnics For example, it is necessary to know this quantity before we can compute the voltage of an alternator or calculate the eddy current losses when testing transformer steels This instrument is being developed in the National Physical Laboratory

Wireless Reception in Naval Ships A paper read by Dr W F Rawlinson before the Wireless Section of the Institution of Electrical Engineers on March 7 discussed problems encountered in the reception of wireless signals in naval ships, and described certain features of the types of apparatus which have been developed for this application In a man of war, the choice of receiving aerials is limited, and it frequently becomes necessary to operate several receivers on different wave lengths from the same aerial Furthermore, in large ships the central receiving room is placed well down below armour, and the distance between the foot of the aerial and the receivers may be up to 100 ft The receivers themselves must be of robust design capable of withstanding the shock of gunfire and of working for years with a minimum of attention in a salt laden atmosphere at temperatures varying from tropical heat to arctic cold Three standard types of receiver were described in the paper, for short, medium and long waves, the total frequency range thus covered being 15-23,000 kilocycles per second These instruments must be capable of rapid tuning to any predetermined wave length, and they must be sufficiently selective to receive weak signals, which are invariably in Morse code, in the presence of a much more powerful signal on a different wave length transmitted either by the same or a nearby ship or by a shore station The concluding portion of the paper dealt with the question of power supply to receivers Common batteries are used to a large extent, but trials are being made with plant designed to take the supply from the ship's mains, special devices being incorporated to stabilise the output in the presence of considerable variation of the main's voltage

Testing Petroleum Stills A paper was read by A H Goodliffe on the practical testing of a continuous petroleum still before a joint meeting of the Institutions of Chemical Engineers and Petroleum Technologists on March 21 The paper gave a description of a plant on which experiments have been carried out, together with results obtained, and further included a detailed log of a particular run of the plant, there followed calculations on the plant and equipment and, finally, qualitative analyses of one of the distilling columns with special reference to the action of bubble trays in promoting fractionation The description of plant included an explanation of a flow diagram of the continuous still employing two towers of similar design, with further details of heating equipment duplex pumps for feeding the crude to the plant and automatic temperature control The log of the run of the plant set forth full details of a trial made last year both as regards specification of the crude, residue and product, which in this case was white spirit The most constructive part of the paper, however, was that dealing with calculations on plant and equipment, which provided much valuable information usually only available from internal reports of refineries No special apparatus was required to secure the necessary information for determining balances, performance and efficiencies beyond that in normal use in all refineries, and much of the testing apparatus used did not transgress the normal chemical requirements of all oil testing laboratories

Dr. Harlow Shapley

At the beginning of this year, Dr Harlow Shapley, director of the Harvard College Observatory and Paine professor of astronomy at Harvard since 1921, was awarded the Gold Medal of the Royal Astronomical Society for his studies of the structure and dimensions of the galactic system On May 11 he will deliver the George Darwin Lecture of the Society, taking as his subject "Some Structural Features of the Metagalaxy



Dr Harlow Shapley

Dr Shapley was on the staff of Mount Wilson Observatory from 1914 until 1921, and during that period probably his most important contributions were the photometric studies relating to stellar clusters An adaptation of the relation between the apparent brightness and the period of a Cepheid variable resulted in his determination of the now universally accepted 'period luminosity' curve, by the aid of which great celestial distances are derived

By means of this or an allied method, Dr Shapley found the globular clusters to be at distances from 20,000 to 200 000 light years, a conclusion which revolutionised previous conceptions of the size and arrangement of the stellar universe His many new ideas on various astronomical topics, especially variable stars, gave rise to pioneer investigations such as a study of spectral changes in Cepheids, whence came his 'pulsation theory' or periodic flow and ebb of heat' as the cause of such variation

In 1921, Dr Shapley was appointed Paine professor of astronomy at Harvard University and director of Harvard Observatory He at once began to plan and carry forward a large variety of celestial explorations, extending from the casual meteor caught in the earth's atmosphere to the remotest nebulous patch on the Bruce photographs of long exposure for metagalactic surveys His meteor project is apparently the first intensive professional attempt to study shooting stars systematically A careful examination of about 100,000 Harvard photographs yielded a total of only 550 trails Since many more meteors can be seen visually than are ever photographed, Dr Shapley organised, about two years ago, with the assistance of Dr E J Opik, an expert corps for the study of these objects, with observations in the clear Arizona sky and analysis at Tartu, Estonia About 26,000 meteors were seen An interesting first result is that only thirty per cent of the visual meteors are from the solar system, the fainter ones coming from interstellar space Therein lies a hope of additional knowledge concerning the great ocean of space around us

A few other subjects in the large observational programme at Harvard may be mentioned The Magellanic Clouds are being studied intensively by several members of the staff, and have already yielded numerous super giants, new peculiar spectra, clusters and variables The programme for systematic examination of the Milky Way in 196 selected regions has already resulted in the discovery of twenty five hundred new variables and the determination of many periods

The problem of the extra galactic nebulæ is now progressing steadily The publication in 1932 of a catalogue giving the positions and photographic magnitudes of all extra galactic nebulæ brighter than the magnitude 13 0, left the way clear for observational work on the second survey reaching to the eighteenth magnitude and to the distance of about a hundred million light years The number already found on the Harvard plates exceeds one hundred thousand, and five hundred or more are often revealed by the examination of a single photograph

The long established practice of the Harvard Observatory in being a collector of facts has thus been continued by Dr Shapley in many lines of research The theoretical side is also being stressed; for example, discussions of orbits, statistical studies of star distribution, and researches upon the origin of spectral lines and on the universal abundance of elements

Dr Shapley's activities are, however, by no means limited to observatory tasks All human problems interest him and his versatility is illustrated by helpfulness in various educational problems it may be counselling non scientific faculties of several colleges as to advantageous research problems or perchance advising the Board of Trade of a textile city during the present collapse of industrial values as to the most judicious expenditures for educational purposes

It is not generally known that Dr Shapley's most interesting recreation is the study of ants For two years on Mount Wilson he observed and studied the habits of trail running ants seventy thousand of them on some summer days going along each file Under varying atmospheric conditions he measured their speed at fixed intervals of distance The fact was established that their speed is a function of temperature alone and increases fifteen fold with an increase of 30° C in air temperature Conversely a single observation of the ant speed led to the prediction of the temperature within 1° C Thus to his period luminosity and spectrum period relations among the stars he added the speed temperature relation among ants Descriptions of some of these observations will be found in the paper Thermo kinetics of *Liometopum apiculatum* Mayr published in the *Proceedings of the National Academy of Sciences* for April 1920 Dr Shapley has also studied the morphology of ants as evidenced by his large collection of worker ants with wing vestiges described in a Note on Pterergates in the Californian Harvester Ant (*Psyche* 27 No 4)

Perhaps his study of ants taught Dr Shapley not only speed but also conservation of energy for with all his other activities he has found time to compile the Source Book in Astronomy and to write books such as Star Clusters and five chapters in the Universe of Stars a pioneer series of radio talks given in 1925 by members of the Observatory staff As a lecturer either at universities or before the general public he is very successful Why this is so may be readily understood by reading his small books Sidereal Explorations and Flights from Chaos based on lectures given at the Rice Institute of Texas and the University of the City of New York

A J C

Scientific Research in Relation to Patents in the United States*

SINCE the War scientists have been called upon by industry in increasing numbers for assistance in overcoming technical difficulties involving such problems as improving old products or processes or devising entirely new products This dependency of industry upon science has been particularly marked in the chemical and electrical fields where large industrial research laboratories have been established for investigating all phases of the products of their respective organisations From their original task of mere laboratory control of the manufactured products these industrial laboratories have extended their sphere of activity to such a large extent as to include research in the fundamental sciences Industrial leaders have come to realise that fundamental research may be of vital importance to industry for it may revolutionise existing practices or create new ones in the most unexpected quarters

PATENTABLE INVENTIONS OTHER THAN MEDICAL

These increasing contacts of scientists with the problems of industry have brought to the fore the difficult problem of adequate remuneration for their services, as well as the problem of giving the public the effective benefit of their work In many cases valuable solutions have been made to difficulties which were patentable Scientists have also begun to realise that many of the fruits of their research have valuable industrial applications which can be patented The troublesome questions thus arise Should they proceed to obtain patents ? What are the advantages in doing this ? What are the disadvantages ? A good deal of discussion has already occurred on these questions but no definite policy has yet been formulated The investigator who takes advantage of our patent laws is perfectly warranted in his act not only for any possible financial returns but also for the good of the public The obtaining of some remuneration from a patent is no more debasing or tainted with commercialism than the acceptance of copyright royalties from a text book or even receiving a salary for teaching We are at present living in an economic structure in which the making of legitimate profit is a fundamental assumption

There are many advantages in securing patents for important advances as only by means of patents can the legal right be secured to exclude others from practising a given process or commercialising a new product By having such control of new discoveries the investigator is assured that his results will be used only for proper and meritorious purposes He can prevent the exploitation of the public by dictating the terms under which his patent should be worked and even control the character of the commercial advertising

MEDICAL PATENTS

The committee recognises the fact that there exists in many quarters a strong feeling against medical patents This feeling seems to be largely due to the unpleasant memories of the past exploitation of the public by means of patent medicines which had doubtful or decidedly harmful effects on the public health Government regulation during recent years has eliminated a great deal of misrepresentation and false claims in regard to this class of goods The Patent Office moreover now seldom issues patents for the old fashioned type of patent medicines It is therefore an error to class all medical patents with the former types of patent medicines

The mere fact that medical patents offer the means of making profits is not a sufficient reason to condemn them entirely It must be remembered that patents have other very important uses Moreover we must bear in mind that it is possible to obtain profits from medical discoveries in many other ways without resorting to patents if the medical investigator is so inclined We must after all depend upon the integrity and character of the investigator when important medical discoveries are involved

The ideal to strive for may perhaps be that no medical discoveries should be subject to any restrictions whatsoever In our present commercial economic system, however, and with existing laws and business practices, such an ideal is difficult to attain, since not all may live up to it We must, therefore, guide ourselves in accordance with the economic situation that exists to-day and seek to attain our ideals through the existing economic machinery rather than to ignore it entirely on the ground of ethical consideration alone

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* From 'The Protection by Patents of Scientific Discoveries , being the Report of the Committee on Patents Copyrights and Trade Marks Joseph Rossman (Chairman), F G Cottrell, A W Hull and A F Woods. Occasional Publications of the American Association for the Advancement of Science No 1 January, 1934 Supplement to *Science*, vol. 79 (New York The Science Press.) 50 cents

The act of securing patents for medical discoveries is not unethical in itself, and such act does not necessarily mean that personal profits are sought Under our existing laws and commercial practices dedication to the public of important medical discoveries by mere publication is not always the best procedure to follow The public can often be best served by receiving the benefits of a new medical discovery under the control of a patent Through making a medical discovery it may become the duty of the investigator to make sure by means of patents that the public will actually benefit from his discovery and not be subjected to unfair exploitation by others who may commercialise his discovery

NON PATENTABLE SCIENTIFIC DISCOVERIES

The proposal that the discoveries of scientists be given some legal protection appears on its face to be very reasonable and plausible It would seem that scientists should be the first to desire such rights as a means of receiving compensation for their contributions to industry and society A careful analysis of the whole problem, however, has led the committee to the opinion that no effort should at present be made to develop a plan for protecting scientific property There appears to be no need for such legal protection from the view point of incentive to the scientist or public policy The Committee recognises that the present economic crisis has tremendously diminished the normally available funds for carrying on research so that other sources of potential funds are to be carefully considered at this time It believes, however, that the legal and practical difficulties involved in enforcing any scientific property would eventually arouse an unfavourable public opinion against scientists, owing to the difficulty of enforcing scientific property and the inherent nature of its broad monopoly The results of irksome scientific monopolies would react to the disadvantage of scientists and thus defeat the very purpose for which this proposal is made

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University and Educational Intelligence

CAMBRIDGE —The Jane Ellen Harrison Memorial Lecture will be given on May 5 at 5 p.m in the College Hall, Newnham College, by Dr L S B Leakey, of St John's College The subject of the lecture will be 'The Problem of the Origin of Man'

Prof Buxton has been appointed to represent the University at the Twelfth International Veterinary Congress to be held in New York in August

SCHOOL libraries in the United States are credited with having contributed in no small measure to the improvement in efficiency which has taken place in the schools in the last three decades According to the Dean of the Graduate Library School of the University of Chicago, Dr L R Wilson, whose views on increasing the significance of the school library are published in *School and Society* of December 30, the once prevalent use of the single textbook recitation procedure has been superseded by a method of instruction by which many books and materials are studied Although his theme is the development and fuller utilisation of the school library, his argument implies that its functions are already of great importance He refers, for example to the librarian's "responsibility of co-ordination and generalship in the field of supervised study" and to the library being the principal integrating agency of the entire school' He mentions as deserving imitation the present effort on the part of the librarians of colleges and secondary schools in the Southern States to work out a co-operative plan for supplying school library facilities in rural areas He advocates the provision, in library schools or teachers colleges, of training for the part time teacher librarian in small schools, and the investigation of a number of problems relating to the school library which, he says, have as yet been only slightly considered These he proceeds to discuss under the headings administration, teaching the use of books in libraries standards for school library service, distribution of library resources, measurement of school library influences During the past twelve months the *Journal of Education (London)* has published a series of articles, by specialists in various subjects, on the library requirements of secondary and public schools in Great Britain

TENDENCIES in university education are discussed in the John Adams lecture given in the Institute of Education, University of London, on October 10 by Dr E Deller, principal of the University (London Oxford University Press 1s) Dr Deller examines some of the implications of the growth in number of students which has marked the recent history of so many universities He discerns a danger of over mechanisation, and a menace to academic freedom University administration is susceptible of hypertrophy, as in those Russian institutions where the head is a director, responsible in the same way as the controller of a factory Extensive student enrolment has led in Germany, where the number of unemployed graduates has been estimated to be 90,000, to other perils "The university is to-day a temporary haven of refuge," said Prof Dibelius recently, "for innumerable individuals who otherwise as soon as their school years were over, would sink to the ranks of the proletariat what a dangerous mass of inflammatory, revolutionary material and social embitterment are heaping themselves up now in those old homes of German culture " The number of students in England is not as yet, Dr Deller thinks, excessive, but he holds that the line of advance for the future must be qualitative rather than quantitative How views as to the proper functions of a university increasingly diverge he shows by quoting from "The University in a Changing World": in Russia and Italy, and more recently in Germany also, the view prevails that all learning must be related to the dominant political creed He suggests that universities can best help forward the rehabilitation of a distressful world by ascertaining truth rather than by attempting the adjustments and compromises, which are the proper task of the statesman, and also by extra mural teaching

Science News a Century Ago

Anode and Cathode

Faraday, when he read his Seventh Series of Experimental Researches in Electricity" before the Royal Society in January 1834, made use of a number of new words in describing the electro chemical phenomena with which the Series is concerned When, later in the year, the paper appeared in print, some of these terms had been changed, and a footnote added in which it was explained that the alterations had been made in order that the new words should be only such as were at the same time simple in their nature, clear in their reference, and free from hypothesis" In the interval Faraday had been in correspondence with friends, and the discussion *produced that series of terms, essential to electro chemistry*, which has since passed into common usage One of his correspondents was W Whewell, afterwards Master of Trinity College, Cambridge, who wrote on May 6

I still think *anode* and *cathode* the best terms beyond comparison for the two electrodes The terms which you mention in your last shew that you are come to the conviction that the essential thing *is to express a difference* and nothing more This conviction is nearly correct, but I think one may say that it is very desirable in this case to express an opposition, a contrariety, as well as a difference The terms you suggest are objectionable in not doing this They are also objectionable, it appears to me, in putting forward too ostentatiously the arbitrary nature of the difference To talk of Alphode and Betode would give some persons the idea that you thought it absurd to pursue the philosophy of the difference of the two results, and at any rate would be thought affected by some Voltode and Galvanode labour no less under the disadvantage of being not only entirely, but ostentatiously arbitrary, with two additional disadvantages, first that it will be very difficult for anybody to recollect which is which, and next that I think you are not quite secure that further investigations may not point out some historical incongruity in this reference to Volta and Galvani I am more and more convinced that *anode* and *cathode* are the right words"

The letter, which is preserved at the Royal Institution, is reproduced in Facsimile in "Faraday's Diary", vol 2

Mural Circle for Edinburgh Observatory

On May 6, 1834, at a meeting of the Institution of Civil Engineers, Mr Simms gave an account of the six foot mural circle just completed for Edinburgh Observatory The instrument, he said, differed in no important respects from those at Greenwich His paper contained a valuable review of the art of dividing instruments Mr Simms said that about the middle of the eighteenth century, Mr Hindley, a clockmaker of York, introduced several important improvements He gave motion to the plate of a tangent screw, invented a frame for carrying a point, in place of using a knife against the fiducial edge of a ruler, and also introduced the elliptical cutting point The Duc de Chaulnes was the first who made use of double microscope micrometers in dividing Ramsden's dividing engine, for which he was rewarded by the Board of Longitude, appeared in 1775 He adopted Hindley's inventions of the endless screw, the cutting frame and the elliptical point, but his machine abounded in beautiful and ingenious contrivances Many dividing engines had been made in Great Britain, by Dollond, Stancliffe, John and Edward Troughton, and abroad by Reichenbach and Gambey For the Edinburgh circle the divisions were cut on a band of gold inlaid on the circumference and the degrees were engraved upon a band of palladium slightly alloyed with silver

Lyell on the Loess Deposits

At a meeting of the Geological Society held on May 7, 1834, Lyell read a paper on the Loamy Deposit called Loess in the Valley of the Rhine', in which he described his investigations made in *1833* between Cologne and Heidelberg and in other districts From his examination of the shells contained in the loess at various places and a study of the land and aquatic shells obtained from the banks of the Rhine, he concluded that (1) the loess was the same material as the sediment with which the waters of the Rhine were charged, (2) the fossil shells in the loess were all of recent species, (3) the number of individuals belonging to land species usually predominated over the aquatic, (4) although the loess when pure appears unstratified it must *have been formed gradually*, (5) some volcanic eruptions must have taken place during and after the deposition of the loess The deposits of loess between Heidelberg and Heilbronn, he said, appeared to attain a height of seven or eight hundred feet above sea level

Darwin in Patagonia

About a month before H M S *Beagle* passed through the Straits of Magellan into the Pacific and while the ship was still in the mouth of the Santa Cruz, Darwin recorded in his Diary on May 9 11, 1834 I took some long walks, collecting for the last time on the sterile plains of the Eastern side of S America ' He also wrote The sportsmen have altogether been very lucky Ten guanaco have been killed and eaten, several condors and a large wild Cat have been killed and Mr Stuart shot a very large Puma" These various creatures were fully described in his Journal of Researches", and of the guanaco he said "The guanaco, or wild Llama, is the characteristic quadruped of the Plains of Patagonia, it is the South American representative of the camel of the East It is an elegant animal in a state of nature, with a long slender neck and fine legs The guanacos appear to have favourite spots for lying down to die On the banks of the St Cruz, in certain circumscribed spaces, which were generally bushy and all near the river, the ground was actually white with bones On one such spot I counted between ten and twenty heads I particularly examined the bones, they did not appear as some scattered ones which I had seen, gnawed or broken, as if dragged together by beasts of prey The animals in most cases must have crawled, before dying, beneath and amongst the bushes Mr Bynoe informs me that during a former voyage he observed the same circumstance on the banks of the Rio Gallegos I do not at all understand the reason of this, but I may observe, that the wounded guanacos at the St Cruz invariably walked towards the river"

Societies and Academies

London

Royal Society, April 26 F W P Götz, A R Meetham and G M B Dobson Vertical distribution of ozone in the atmosphere A method has been developed for finding the average height of the ozone in the earth s atmosphere and also the general character of its vertical distribution This method uses spectroscopic measurements of the light of the clear blue zenith sky as the sun is rising or setting The necessary observations have been taken in Switzerland over the space of a year and the height and vertical distribution have been calculated The average height is found to be about 22 km above sea level and most of the ozone exists between the ground level and 40 km The vertical distribution depends on the total amount of ozone present but apparently not greatly on other factors F P Bowden and C P Snow Physico chemical studies of complex organic molecules (1) A method is described for the production of monochromatic light of sufficient intensity to bring about reasonably rapid photochemical changes The irradiation can be performed on very small amounts of material and the progress of the reaction followed spectroscopically Selective monochromatic irradiation is applied to some of the large molecules of biological importance notably ergosterol and calciferol vitamin B, carotene and vitamin A F P Bowden and S D D Morris Physico chemical studies of complex organic molecules (2) The absorption spectra of some important biological molecules have been measured at liquid air temperature The bands of β carotene (in ethyl alcohol) become narrower and shift to 4990 A 4670 A and 4350 A and a new band appears at 4060 A The ultra violet band at 2700 A becomes sharper but is little displaced The main band of vitamin A concentrates at 3280 A is shifted to 3350 A and new structured bands appear at 2900 A 2770 A 2580 A 2510 A and 2430 A The absorption spectrum of vitamin E concentrates is due to several different molecules and some progress has been made in separating these out

Dublin

Royal Dublin Society, January 23 T N Richardson and K C Bailey The oxidation of hydrazine by potassium ferricyanide When this reaction takes place in alkaline solution supersaturation by nitrogen gas takes place so readily that the reaction can only be followed by the rate of evolution of gas if stirring is very efficient Acetone retards the reaction by formation of dimethylketazine which is not oxidised under the conditions of the reaction Robert McKay Injury to apple trees due to mineral oils used for the control of woolly aphis A canker on maiden apple trees originating in a nursery in the south of Ireland was traced to the use of paraffin oil for the control of woolly aphis Various types of injury produced by paraffin on apple trees of different ages and varieties are described, the injury being aggravated by the presence of woolly aphis Paraffin oil or petrol should not be used alone on apple trees at any season

Paris

Academy of Sciences, March 5 (*C.R*, 198, 861–996) * Pierre Carré and Jean Pasche The relative mobilities of the propyl and isopropyl radicals and of their mono and dichlor-derivatives M Tiffeneau and Mlle B Tchoubar The mechanism of formation of the cyclohexanones by the action of organo magnesium compounds on the α-chlorocyclohexanones The indirect replacement of the halogen by alkyl Georges Richard A new example of an abnormal reaction of potassium cyanide on an α chloroketone Léon Enderlin Researches on the dissociable organic oxides Two oxidation terms reducible but not dissociable of *bis* paratolyl 1 1 diphenyl 3 3 rubene the tetrahydro *bis* epoxyl and dihydrodihydroxyl derivatives E Balla Some aryl glycols L Royer Observations concerning substances which modify the facies of crystals depositing from a solution Paul Gaubert Liquid crystals obtained by the rapid evaporation of an aqueous solution Anatole Rogozinski Crystal analysis with the X rays by a method of focalisation A S Mihara The altered form of the felspars in the granitic sands of the Vosges M E Denaeyer The chemico mineralogical composition of the basic rocks intrusive or metamorphic of Kasai (Belgian Congo) Erhart The existence of palæo soils in the Quaternary deposits of the Sarre valley and on their nature Jacques Bourcart and Georges Choubert Some eruptive rocks brought by the Ouezzan Trias (Morocco) Raymond Furon The geological and geographical relations of the Hindu Kush and the Pamir Pierre Urbain The separation of the various constituents of clays Description with diagram of an electrical method G Grenet The measurement of the terrestrial electric field and of its variations Louis Emberger The vegetation of the massif of Seksaoua (Western Grand Atlas) A Maige Remarks on the metabolism of the nucleus and the plastids in plant cells Mlle Gilberte Pallot Cytological researches on the neuromuscular spindles Mlle L Guyon The phenomena which occur in solutions of collagen at the limits of action of acids and neutral salts Raymond Hamet The initial manifestations of sympathicolytic action of yohimbine H Laugier E Toulouse and D Weinberg Biotypology and academic classification L Lapicque Remarks on the preceding communication Maurice Nicloux The diffusion of alcohol in the organism and bound water Mme Yvonne Khouvine The reduction of W C Austin s *α-d* glucoheptulose Mlle O Grootten and N Bezssonoff The factors which arrest the synthesis of a bacterial pigment B S Levin and Iwo Lominski The influence of colloidal lecithine on the phenomena of microbial lysis by the bacteriophage L Balozet Concerning the immunity towards infectious anæmia of horses Pierre Rosenthal Embryotherapy Charles Richet Remarks on the note by P Rosenthal relating to embryotherapy

* *Continued from p 659*

Leningrad

Academy of Sciences (*C.R*, No 1, 1934) S N Bernstein The linear quasi continual chains of Markov I M Vinogradov New applications of trigonometrical polynomes M Romanova, A Rubzov and G Pokrovskij Silver plating of mirror surfaces by means of cathode sputtering Mirrors have been prepared in a hydrogen atmosphere of 0 004–0 005 mm mercury pressure, with a current of 15–20 m.A, the voltage between the electrodes being 1,200–1,400 B A Nikitin A qualitative reaction for radium If to 10 c c of a solution of radium chloride heated to the boiling point, 0 3 c c of 50 per cent CCl_3COOH and 0 5 c c of 10 per cent potassium chromate are added and the mixture cooled to 0° C , then a crystalline precipitate is formed Similar solution of barium produces no precipitation after such treatment A **Bach**, Z **Ermolieva** and M **Stepanian** Fixation of atmospheric nitrogen by means of enzymes extracted from *Azotobacter* The juice of cultures of *Azotobacter* obtained under a pressure of 300 atmospheres and filtered through Chamberlain's L_3 candle, proved to be able to fix atmospheric nitrogen in the presence of a solution of glucose, or of mannite This juice fixed ten to twenty times the quantity of nitrogen as compared with live cultures A **Nikolaev**, V **Vdovenko** and P **Pochil** Artificial dehydration of hydrated salts by means of solar energy Having placed films of kerosene, petroleum and naphtha oil upon crystalline hydrated sodium sulphate, the authors observed its conversion, on exposure to sunlight, into dehydrated salt This was due to the film preventing the evaporation from the salt and the consequent heating up of the latter S **Balachovskij** The problem of carotine in the organism Burns and other wounds treated by a solution of carotine healed quickly It appears that in wounds local avitaminosis occurs and the introduction of carotine restores the balance J **Kerkis** Hybridisation between *Drosophila melanogaster* and *D simulans* and the question of the causes of sterility in interspecific animal hybrids The conditions favourable to normal development of germ cells in hybrids may sometimes occur, but further investigations are necessary to discover these conditions M **Tchailachian** The effect of length of the day upon the chlorophyll apparatus of plants The accumulation and the content of chlorophyll in plants growing under natural conditions increase under the influence of the length of day as the distance from the equator decreases O **Vialov** The lower Palæogene in Bukhara

(*C R* , No 2, 1934) I **Vinogradov** New asymptotical expressions V **Kupradze** The radiation principle of Sommerfeld W **Krat** On darkening at the limb in eclipsing binaries N **Andreiev** The possibility of observing Brownian movement with the naked eye Brownian movement of particles in a thin film of fat placed on the surface of a slightly oxidised metallic plate can be observed as fluctuations of light in a diffraction spectrum G **Tchelintsev**, I **Knuniang** and Z **Benevolenskaia** The structure and synthesis of new antimalarial substances Analyses of Plasmochin' and Atebrin A **Charit** and I **Fedorov** The oxidation and reduction processes during muscular contraction The authors studied the changes in the oxidation reduction potential of Ringer's fluid passing through the isolated pulsating heart A **Studitskij** The potencies of the periosteum of primary and secondary ossification according to the data obtained by the cultivation of periosteal grafts on the allantois A A **Prokofjeva** Investigations on the chromosome morphology of some fishes and amphibians The chromosome structure of the species under investigation corresponds to the principles of structure observed in plants and gives grounds for supposing a process of karyological evolution common to both the animal and the vegetable kingdom S **Soldatenkov** and M **Cubli** The effect of ethyl alcohol on the ripening of tomatoes Positive results have been obtained in the experiments E **Gurjanova** The Crustacea of the Kara Sea, and the ways in which the Atlantic fauna penetrates into the Arctic The Atlantic species pass into the Arctic along the slope of the continental shelf, not far from the Scandinavian coast

ROME

Royal National Academy of the Lincei Communications received during the vacation, 1933. U **Cisotti** Differential deductions from the definition of reciprocal vectors (1) Q **Majorana** New types of compensator for metallic photo resistance The mercury jet compensator may be replaced by a type in which a photoelectric cell is employed L **Fantappiè** Integration by quadrature of the general parabolic equation with constant coefficients G **Scorza Dragoni** The multiplication of series which converge conditionally (2) **Maria Cibrario** Certain generalisations of the numbers and polynomials of Bernoulli and Euler B **De Finetti** The laws of distribution of values in a succession of equivalent aleatory numbers E **Picasso** The projective differential geometry of the surfaces of S_4 A **Terracini** The congruences of straight lines associable with respect to a surface B **Segre** Geometric functional determination of groups of covariant points, relative to two linear pencils of curves on an algebraic surface G **Arrighi** A generalisation of the equation of continuity A **Colacevich** Spectroscopic observations of the variable star RS Ophiuchi (Nova Ophiuchi *n* 3) F **Pirrone** and A **Cherubino** Studies on the hydroxyquinolines Iodo derivatives of *o* hydroxy quinoline (1) α Iodo *o* hydroxyquinoline and a number of its derivatives have been prepared G **Moruzzi** Contribution to the study of cerebellar localisations by the method of transneuronic degenerations G **Amantea** The antineuritic factor (B_1) and the conception of the beri beri quotient (Q_b) A series of twenty points emerging from the author's investigations on beri beri in pigeons is formulated so as to indicate the logical evolution of the idea of a beri beri quotient A **Salvatori** A method for the micro determination of bromine in blood and organs Roman's method (1929), which consists in converting the bromine into potassium bromide by fusion with potassium hydroxide, liberating the bromine by treatment with hydrogen peroxide treating with potassium iodide, and titrating the liberated iodine gives unsatisfactory results V **Zagami** Food value of the seeds of *Vicia Faba* L The results of a large number of further tests show that these seeds form an incomplete or deficient nutriment for growing rats, the deficiency relating both to salts and to vitamins A and D Vitamins B and E are, however, present in adequate proportions

MELBOURNE

Royal Society of Victoria, Nov 16 **Audrey M Eckersley** Some sap staining organisms of *Pinus radiata*, D Don in Victoria Two forms of *Ceratostomella* were isolated from sap stained *Pinus radiata* case stock When compared with stand cultures of *Ceratostomella*, it was found that these forms appeared to form a link between the American species *C pilifera* (Fr), Winther, and the European species *C coerulea*, Munch , which are very closely related if not identical The two new forms in their morphological characters approximate sometimes to one and sometimes to the other but the varietal distinctions are not all clear-cut and it is suggested that all four forms belong to a single species which is capable of exhibiting variation to a marked degree *Hormonema dematioides* Lagerberg et Melin was also isolated from sap stained *Pinus radiata* **Frederick Chapman** A Lower Cretaceous brittle star from Queensland This well preserved brittle star is named *Ophiacantha* (*Ophioglyphoida*) *fosteri sub genus et sp nov* It was obtained from a bore core at Cleve Longreach Queensland and is defined by the pentagonal covering plates of the disc The new specific characters are the petaloid shape of the disc long slender arms more than five times the diameter of the disc in length with constricted vertebral ossicles and abundant slender thorny spines It occurred in the Tambo series probably near the base It is of great interest to note that by the discovery of a fossil *Ophiacantha* in the Cretaceous of Longreach this particular genus has persisted from Lower Cretaceous times to the present It is also one of the most abundant of brittle stars living in Australian seas Its present range is from southern Tasmania to the Philippines

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Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Saturday May 5

University of Cambridge at 5—(in the New Museums) —Sir Henry Dale Chemical Transmission of the Effects of Nerve Impulses (Linacre Lecture)

University of Cambridge at 5—(in the College Hall Newnham College) —Dr L S B Leakey The Problem of the Origin of Man (Jane Ellen Harrison Memorial Lecture)

Monday May 7

Royal Geographical Society at 5 —Dr L S B Leakey Lake Victoria in the Pleistocene

Tuesday May 8

Royal Horticultural Society at 3 30—(at Greycoat Street Westminster S W 1) —Dr W F Bewley Health and Disease in Plants (Masters Memorial Lectures Succeeding lecture on May 9)

Chadwick Public Lecture at 5 30—(at the Royal Society of Tropical Medicine and Hygiene 26 Portland Place W 1) Dr Jane Walker Village Hygiene *

Illuminating Engineering Society at 7—(at the Institution of Mechanical Engineers Storey s Gate, St James s Park S W 1) Annual General Meeting S G Hibben Recent Progress in Illuminating Engineering in the United States

Wednesday May 9

Institute of Metals at 8—(at the Institution of Mechanical Engineers Storey s Gate Westminster S W 1) —Prof E K Rideal Gases and Metal Surfaces

Institute of Metals —Prof E K Rideal Gases and Metal Surfaces (Annual May Lecture)

Thursday May 10

University of Oxford at 5 30—(in the Examination Schools) —Prof H J Rose Concerning Parallels (Frazer Lecture)

Institution of Electrical Engineers at 6 —Annual General Meeting

Friday May 11

Royal Astronomical Society at 5 —Dr Harlow Shapley Some Structural Features of the Meta galaxy' (George Darwin Lecture)

Royal Institution at 9 —Dr C Leonard Woolley 'This Year s Work at Ur

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Official Publications Received

Great Britain and Ireland

Annual Reports on the Progress of Chemistry for 1933 Vol 30 Pp 462 (London Chemical Society) 10s 6d

Royal Institute of British Architects Report of the Slum Clearance Committee Pp 28 (London.)

Reports of the Council and Auditors of the Zoological Society of London for the Year 1933 prepared for the Annual General Meeting to be held on Monday, April 30th 1934 Pp 108 (London)

Imperial Bureau of Plant Genetics Bibliography of Baking Quality Tests (with particular reference to Tests for Small Samples for use by Wheat Breeders) Pp 68 Plant Breeding in the Soviet Union Achievements Organisation and Future Programme of the Institute of Plant Industry Pp 58 3s 6d (Cambridge School of Agriculture)

The Men of the Trees Ninth Year's Report and Review of the Tree Year 1933 Pp 36+4 plates. (London Hon. Secretary 32 Warwick Road S W 5) 6d

Other Countries

Publications of the Vassar College Observatory No 4 Part 1 The Longitude of the Vassar College Observatory prepared for publication by Caroline E Furness Part 2, A Study of Four Be Stars, by M Alberta Hawes. Pp iii+60+5 plates. (Poughkeepsie N Y)

The Indian Forest Records Vol 19 Part 8 Entomological Investigations on the Spike Disease of Sandal (18) Fulgoridæ (Homopt.) By N C Chatterjee and M Bose Pp 14 (Delhi Manager of Publications) 5 annas 6d

U S Department of Agriculture Miscellaneous Publication No 186 Reconnaissance Erosion Survey of the Brazos River Watershed, Texas By H V Geib and Ira T Goddard Pp 47 10 cents Technical Bulletin No 402 Biology and Control of Tree Hoppers injurious to Fruit Trees in the Pacific Northwest By M A Yothers Pp 46 10 cents. (Washington D C Government Printing Office)

Veröffentlichungen aus dem Kaiser Wilhelm Institut für Silikatforschung in Berlin Dahlem Herausgegeben von Prof Dr Wilhelm Eitel. Band 6 Pp 234 (Braunschweig Friedr Vieweg und Sohn A G) 28 gold marks

Achema Jahrbuch Jahrgang 1931 34 Berichte über Stand und Entwicklung des Chemischen Apparatewesens. Begründet von Dr Max Buchner Herausgegeben unter Mitwirkung von Fachgenossen aus Wissenschaft und Technik von der Dechema Pp 296+xxxiv+44 (Seelze und Berlin Deutsche Gesellschaft für Chemisches Apparatewesen E V) 10 gold marks

The Science Reports of the Tôhoku Imperial University, Sendai Japan. Second Series (Geology) Vol. 16 No 2 Marine Mollusca from the Ryûkyû Limestone" of Kikai sima Ryûkyû Group By Sitihei Nomura and Noboru Zinbô Pp 56+1 plate. (Tôkyô and Sendai Maruzen Co , Ltd)

Proceedings of the American Academy of Arts and Sciences. Vol. 69 No 2 The Rotation of Cobalt and Nickel by Magnetization and the Gyromagnetic Ratios of their Magnetic Elements By S. J Barnett Pp 119–135 (Boston, Mass.) 45 cents.

N Z Department of Scientific and Industrial Research Apia Observatory, Apia, Western Samoa Annual Report for 1932 Pp vii+114 (Wellington N Z Government Printer) 5s

Bulletin of the American Museum of Natural History Vol 67 Article 4 Fossil Invertebrata from Northeastern Brazil. By Carlotta Joaquina Maury Pp 123–179+plates 9–19 (New York City)

University Observatory Oslo Publication No 8 i On the Stability of Atkinson s Star Models, ii A Note on Stellar Stability By G Steensholt Pp 8 Publication No 11 Die Störungen des zirkularen Wirbels einer Homogen Inkompressiblen Flüssigkeit Von O L Godske Pp 130 Publication No 12 On the Trajectories of Electric Particles in the Field of a Magnetic Dipole with Applications to the Theory of Cosmic Radiation, II By Carl Størmer Pp 47 (Oslo A W Brøggers Boktrykkeri A.-S)

The Imperial College of Tropical Agriculture The Principal s Report for the Year 1932–33 and the Accounts for the Year ended August 31 1933 Pp 32. (Trinidad and London.)

Catalogues

The N and W Shockproof Mobile X Ray Unit (Publication No 34/01) Pp 8 (London Newton and Wright, Ltd.)

McGraw Hill Books on Agriculture, Zoology and Botany 1934 Pp 20 (London McGraw Hill Publishing Co Ltd.)

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Science and Intellectual Liberty

A LITTLE more than a year ago a number of scientific workers and scholars formed themselves into an Academic Assistance Council with the intention of helping university teachers and investigators who on grounds of religion political opinion or race were unable to carry on their work in their own country The Council consists of forty two members representative of all sides of British intellectual activity and its first annual report which has just been issued is a document worthy of careful study* Upon the Council s records are the names of 1 202 scholars and scientific workers who have been displaced Of these rather more than a quarter 389 have been permanently or temporarily—in the majority of instances only temporarily—enabled to continue their work 178 in the British Isles 211 abroad There remain 813 so far unsuccoured

Although the Council does not confine its aid to those of German origin nearly all these distressed intellectuals have come from or still suffer in Germany It might seem then that the Germany of to day is not a very kindly soil for the cultivation of science and scholarship Prof J Stark president of the Physikalisch Technische Reichsanstalt Berlin has however been at some pains to demonstrate both in our correspondence columns and also in a pamphlet entitled National sozialismus und Wissenschaft † that far from seeking to diminish scientific freedom it is the mission of the National Socialist Government to free German science from the influences which were strangling it

It is necessary first of all to realise the distinction in the German political mind at the present time between *Germanen* and *Juden* To *Germanen* has been vouchsafed the gift of seeing things as they really are with the result that practically all *Naturwissenschaft* is regarded as the creation of the Nordic German branch of the Aryan peoples The *Juden* on the other hand are entirely centred on themselves cannot or rather will not see things as they really are and only respect facts which can be made subservient to their own ends They are consequently quite incapable of making any great discoveries in *Naturwissenschaft* It is true that Heinrich Hertz made an important discovery but then Hertz had a Germanic mother

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* The Academic Assistance Council Annual Report, 1st May 1934 (London c o Royal Society, Burlington House, London W 1)

† Zentralverlag der N S D A P München 1934

We might also mention names, such as those of Jakob Henle and Paul Ehrlich , whether anatomy and immunology are not *Naturwissenschaften* at all, or the pedigrees of Henle and Ehrlich have been insufficiently scrutinised, we do not know The result of the moral and intellectual limitations of the *Juden* has been, not only that they have devoted themselves to unreal theorising, but also that little Jewish coteries have succeeded in strangling genuine German science One of these *judische Wissenschafter Konzerne* founded by Klein and Hilbert no doubt discouraged that stern objectivity which should characterise Nordic German mathematics , another, controlled by Einstein and Sommerfeld, tampered with physics a third, the Haber *Konzern*, has strangled physical chemistry What *Konzern* has suppressed Germanic biology is not disclosed Anyhow, we are apparently led to the conclusion that, instead of discovering anything important, Germany has been simply putting on the market dogmatic theories, such as Einstein's theory of relativity

It may be difficult for the English reader, recalling the often painful elaboration of genuine Germanic humour, not to suppose that Nationalsozialismus und Wissenschaft' is a facetious essay, but the consequences of its acceptance in Germany are too plainly evident No one can suppose however, that this kind of reasoning' will be taken seriously long Even the Committee of Public Safety was not wholly composed of Barères more temperate counsels will prevail in Germany in good time Meanwhile, however, a good deal of 'sand' is being thrown into the intellectual machinery of the world

One function of the Academic Assistance Council has been to enable serious workers to escape from an atmosphere of noise and truculence and to continue their researches The reports of what has already been done by grantees show the success of the policy One (a mathematician) has finished an exceptional piece of work which will make a considerable sensation when it appears and add greatly to his status ' Another (a physiologist) has done work which, the referee thinks, "may well be revolutionary ' Another (an art historian) ' has been doing quite invaluable work" , and so the story goes on

These are the products of a single year's work and of comparatively trifling expenditure Were we only concerned for the credit of Great Britain and the enrichment of its intellectual life, we might almost pray that the present vogue in Germany would be long It would be difficult indeed to invest capital at a more usurous rate of interest—we are securing some of the best intellects in Europe, perhaps permanently However we all hope that the restraint of German intellectual activity will not continue , but common prudence must warn us that, for some years to come, much of the burden of maintaining the intellectual life of Europe will have to be borne by us The Academic Assistance Council estimates that £25,000 a year for the next two years will be necessary to enable it to continue and consolidate its work In 1931–32, according to the return of the University Grants Committee, the expenditure in Great Britain on salaries (including payments for superannuation) of teaching staff in university institutions of Great Britain was £2,856,216 The annual sum required by the Academic Assistance Council is less than one per cent of this While it would be preposterous to suggest that the whole of the burden can be, or should be, borne by the academic staffs of British universities, and reasonable to expect that enlightened men of wealth will contribute to this deserving object, it does at least appear that the Council is not asking for a sum beyond the means of those who value science and scholarship to supply

We doubt whether an appeal more worthy of support than this has ever been made to the educated public We have the ordinary appeal to decent human sympathy which the story of oppression makes, but beyond that is the appeal to our imagination The individuals suffering at present will pass away and be forgotten the revocation of academic freedom in Germany will no more be forgotten than the revocation of the Edict of Nantes

A Poet Looks at Religion and Science

The Unknown God By Alfred Noyes Pp 383 (London Sheed and Ward, 1934) *7s 6d* net

MR ALFRED NOYES is one of a not inconsiderable number of literary intellectuals who, having begun thirty or forty years ago as agnostics, have become in their maturity orthodox and practising Catholics This spectacle of agnostic poets leaving the waste land and returning *ad limina* is a sign of the times Now that the traditional European culture, which was predominantly literary, is in danger of being displaced by a new scientific culture with its strange products, human and material, the poet may experience a very natural distaste. He sees, or thinks he sees, the world being rapidly decivilised by the mass barbarian, who is a deplorable by-product of scientific developments. He is appalled by the prevalent vulgarity and insensitiveness to the values he cherishes, and repudiates modernity; and who shall say that he is altogether wrong? Compare the shallow philosophy, or philosophies (since there is a Babel of conflicting tongues) of modernity with the *philosophia perennis* of traditional Catholicism—with its richness, its comprehensiveness, its sweep and power of speculation, its nobility and depth of emotional content, and its rationality.

Yet this is not the sort of argument that Mr. Noyes proffers in his book. Out of disgust for the contemporary world he does not repudiate science which has created that world. On the contrary, he begins from the scientific point of view as found in T. H. Huxley, Herbert Spencer and Haeckel. From studying these writers in his youth, Mr. Noyes gained too clear an insight into scientific culture ever to wish to repudiate it out of disgust at a few of its products. Yet his interests in those early days were evidently philosophic rather than strictly scientific. What fascinated him were the perennial problems of space, of time, of personal identity, and so forth.

Yet the Victorian agnostics contained more than a little of the old culture suspended in their thought. "It was not really difficult for Mr. Noyes to discover parallel doctrines, a little differently phrased but not dissimilar in content, in Herbert Spencer and Aquinas. The modern unbeliever is at once more technical (though less verbose) and more tough than the author of the 'Synthetic Philosophy'." This indeed, is part of the trouble to-day. "Our men of science are all specialists, each working along his own narrowing line, each developing a language of his own, and each diverging further and further from that central point of view which once enabled us (from the lost height of a great historic religion) to 'see life steadily and see it whole'."

That is bad enough, though one does not see how it can be avoided. What is far worse is that the philosophers are specialists too. "We get very little that is helpful in constructing a satisfactory synthesis from modern metaphysicians, whose treatises are arid and technical; and if we turn to the poets and artists, they too let us down. Mr. Noyes is a poet himself and should know, and he tells us that art and literature are suffering from the same disease as science itself, in an aggravated form. Their exponents, with few exceptions, have no belief in real values. They are giving over to analysis what was meant for synthesis; and where they should be creative, or interpretative of life in its fulness, they offer us critical dissections and the disintegrated relics of a post mortem. More than ever before they mistake those superficial factual reports for truth; and, if the 'facts' are repulsive enough, they are inclined to suggest that truth requires no further evidence. It is not only the 'facts' of religion that are failing us."

Of course an apologist for the new literature would reply that the industrious and disinterested collection of facts must be preliminary to a synthesis; the task may be extremely unpleasant and even unpromising, but one has to proceed on the inductive principle. Perhaps we shall get our synoptic view in due course, but meanwhile modern writers will not look back for their interpretations and their ideals. They have certainly chosen the more difficult task. To resuscitate the past only calls for erudition and the sympathetic understanding of other people's ideas—in a word, for intelligence. But to provide something new (which is what the times call for), needs genuine creative power, and we may admit that not all our modern writers possess it.

If this is true in art and literature, it is more true than ever in the sphere of religion. As Mr. Noyes most justly says, the need of the world to-day is a religious need, but it is extremely doubtful whether this can now be satisfied by the orthodoxies of the past, however attractive they may be in themselves, however intellectually coherent they may be if you grant their premises, and however much by their grandeur they may expose our modern spiritual penury. "The world is groping," says Mr. Noyes, "for a religion in which it can believe without evasions, without dishonest ambiguities, without self-deception, and without superstition." That is just the point. A religion, however satisfying in other directions, is no good to you unless you can believe it with your whole heart. That Mr. Noyes finds traditional Catholic orthodoxy completely satisfying himself is evident from this utterly sincere and large-hearted book. But not all of us are so fortunate.

J. C. HARDWICK.

Advancing Sterility in Plants

Publications of the Hartley Botanical Laboratories Nos 1, 2, 4, 6, 7 *Studies in Advancing Sterility,* Parts I to V By John McLean Thompson No 11 *The Theory of Scitaminean Flowering* By John McLean Thompson No 3 *The Life History and Cytology of Sphacelaria Bipinnata* By Hilda B Clint No 5 *The Cytology of Callithamnion Brachiatum* By William T Matthias No 9 *A Contribution to Knowledge of the Mesogloiaceae* etc By Mary Parke Nos 8, 10 *Studies of Flowering in Heterostyled and Allied Species,* Parts I and II By James Stirling (Liverpool University Press of Liverpool 1924–1933)

THESE publications of the Hartley Botanical Laboratories of the University of Liverpool are beautifully printed and illustrated on large pages of good paper In them Prof McLean Thompson records his observations of floral development in a few selected families, and supports his view that only through such developmental studies is it possible to interpret floral form and structure satisfactorily In selecting the families for study Prof Thompson has shown himself ready to face difficulties His choice has fallen first on the Leguminosæ, one of the largest families of Dicotyledons, the very variable subfamilies Cæsalpinioideæ and Mimosoideæ having been investigated in considerable detail but the more uniform Papilionatæ much less extensively Next he has chosen the Lecythidaceæ and the Scitamineæ, two groups in which the flowers exhibit a wide range of freakish forms with marked variation in the number of functional stamens

The investigations of the Leguminosæ have been directed towards three main ends first, to find the directions of evolution within the family secondly, to interpret the morphology of the corolla and gynæcium, and thirdly, to reconstruct a prototype It was unfortunate that the Cæsalpinioideæ should have been studied before the Mimosoideæ, since the latter are certainly the more primitive in many respects, and conclusions derived from the former have had to be revised The final conclusions are that evolution has been mainly a progressive reduction in the number of stamens, with the ultimate attainment of monandry and apetalous dicliny The corolla is a secondary intercalation between perianth and androecium, and the legume is the reduction limit from a terminal system of phylloclades with marginal ovules The prototype showed numerous members in a continuous spiral sequence, bracteoles and perianth outermost, then stamens, and finally, on the apex of the long conical receptacle, the gynæcium

For the most part these conclusions seem incontrovertible The constancy of the serial origin of members even in apparently cyclic types is a point of considerable interest This has been observed also in Ranunculaceæ, and an essentially similar picture to Prof Thompson's has been drawn for that family The corolla has been regarded as arising secondarily, and all members as originally arranged in a continuous spiral sequence In both groups the members, as their numbers are reduced, settle down usually to pentamerous, but occasionally to trimerous or tetramerous, alternating whorls The derivation of such cyclic or pseudocyclic arrangements from the spiral offers no great difficulties if it be realised that the average angle of divergence between successive members in spiral types is never far removed from 137 5°, and that an average divergence of 144°, corresponding to the 2/5 phyllotaxy of the old Schimper Braun theory is rarely found Thus members cannot be supposed to have lain along a small Fibonacci number of radii, five eight or thirteen, and Prof Thompson had no need to assume and explain secondary displacements of 36° to remove a sixth member from radial juxtaposition to a first

There is no doubt that the numerous stamens of the prototype have been steadily reduced until, in several species, only one remains This does excuse the frequent use of such expressions as ' doomed", 'menaced by sterility", "await extinction" Much more must be known of the general biology of these types, of their pollination mechanisms and their ecology, however, before drawing a conclusion of suicidal orthogenesis

The evolutionary history of the legume is a much disputed matter Many might agree that the facts of form and vascularity do not support a multi carpellary interpretation It is not difficult to agree that the carpel, growing for the most part by intercalary elongation *after* infolding, is no longer a leaf whatever its form in ancestral types But to call it, with Prof Thompson, a phylloclade, does not seem to help appreciably In the first place there seems no strong reason, on grounds of structure and development, for calling it phylloclade rather than leaf, and in the second place it is far from evident why the organs figured in the reconstruction of the prototype should be called phylloclades rather than leaves There is sore need for a revision of morphological terminology

His studies of the floral development of the Scitamineæ have led Prof Thompson to deny the cymose nature of the peculiar partial inflorescences of such genera as *Musa* He adduces many interesting facts and submits an ingenious interpretation, but it cannot be said that his arguments are entirely convincing The frequent association in pairs of one left handed and one right handed flower is not satisfactorily explained in terms of the direction of movement of nutrient materials but is to be expected in a reduced cymose inflorescence

From a study of individual floral development emerges the fact that again in the Scitamineæ the members arise serially But the most interesting conclusion is that the gynæcium is not composed of carpels but of ovules arising on the walls of a receptacle crater which is roofed in by stylar components The inference is that the Scitamineæ are acarpous' in ancestry This does not seem a legitimate inference The inferior ovary is surely a derivative type in which the ancestral carpels have ceased to bear the ovules and are represented only by the 'stylar components' All stages between this and the hypogynous condition are known and the essential change seems to be in the distribution of growth after initiation of the carpels on a concave receptacle Growth of the carpels as free or concrescent members, independently of the receptacle, gives the superior ovary, but growth predominantly beneath the primordia, increasing the concavity of the receptacle or forming the loculi as pockets beneath the stem apex, gives the inferior ovary It is thus true that the ovary is not composed of carpels, but it cannot be maintained that it is ancestrally acarpous

Observations on the Lecythidaceæ reveal an interesting correlation between cell gigantism and sterility, and progressive sterilisation of the androecium is again recognised as the main evolutionary trend

The publications constitute a valuable collection of data on floral development, and Prof Thompson is to be congratulated on having directed attention to many outstanding problems for the solution of which his mode of approach may justly be claimed indispensable In conclusion it should be said that the drawings of flowers are extremely good, but perspective drawings and longitudinal sections should have supplemented the contoured plans and serial transverse sections in illustrating floral development Why should none of the floral diagrams be orientated in the conventional manner, and why should the inflorescence axis be represented by a little maltese cross or a more elaborate figure ? The large number of unfortunate printing errors of the earlier volumes has been much reduced in later volumes

Publications by other members of Prof Thompson's department deal with the development of heterostyled flowers (Nos 8 and 10), and with the life histories of certain algæ (Nos 3 4, 5 and 9) There are also valuable notes by Mr W Horton dealing with technical points

A R CLAPHAM

World Petroleum Congress

World Petroleum Congress organised by the Institution of Petroleum Technologists held at the Imperial College of Science and Technology, South Kensington London July 19th–25th, 1933 Proceedings Edited by Dr A E Dunstan and George Sell Vol 1 *Geological and Production Sections* Pp xxiv+592 Vol 2 *Refining, Chemical and Testing Section* Pp xxvi+956 (London World Petroleum Congress, 1934) Vol 1 35*s* net to Members of the Congress, 30*s* net Vol 2 45*s* net to Members of the Congress, 37*s* 6*d* net

IT is impossible accurately to assess the value or measure the success of the World Petroleum Congress, held in London on July 19–25 last, for, as with all international meetings of this character, vital problems discussed cannot be solved at the time, but must be referred to various committees of experts Only time and with it much detailed work, can show which of the innumerable ideas propounded at this Congress are of scientific import , many as yet must be classed as interesting but unproved theories Anyone, however, can furnish himself with at least one tangible and lasting memento of this international pooling of current ideas and can extract therefrom such technical information as may be necessary to his particular branch of research or industry The memento is a complete record of proceedings published at the offices of the Congress in two volumes Vol 1 includes all papers submitted in connexion with the Geological and Production Sections Each section and sub section is prefaced by a general reporter s summary giving the trend of present day thought and research at a glance

Geologists throughout the world are bringing the resources of science to bear on vexed problems of petroleum source rocks their geographical limits and the principles governing distribution of oil fields Geophysical science has advanced rapidly during the last ten years and papers on this subject provide an excellent basis of assessment of capabilities and relative usefulness of the numerous instruments now available The value of aeroplane reconnaissance and photography appears to be capable of enhancement and an urgency is obviously felt by its sponsors and operators for its more universal application to cover the vast amount of pioneer work still to be done Stress is also laid on analysis and interpretation of oil well data acquired during drilling—now a very exact science—and on the great assistance which such data though not always appreciated provide to field operators Drilling production transport and storage of oil form the main themes in the Production Section In the first instance opinions are collected and problems discussed chiefly in connexion with pressure drilling use of mud fluids and oil well cementation The second group comprises contributions describing actual production methods as now practised and their relation to reservoir conditions while the last group is of interest mainly from the point of view of modern pipeline construction and protection

Vol 2 contains a great deal more subject matter and includes papers on cracked gasoline refining and the use of inhibitors for gum prevention determination of gum in gasoline knock rating for motors and aviation gasoline fuels for high speed compression ignition engines hydrogenation extraction processes for the refining of oil lubricating oil viscosity bituminous materials and emulsions kerosene alternative fuels oil coal fuels petroleum as a chemical raw material and measurement of oil in bulk Two important considerations concern nomenclature from the legal aspect and international co operation in standardisation

Both volumes conclude with an account of the formal adoption of resolutions Sir John Cadman s lecture on Science in the Petroleum Industry and also Mr J B Aug Kessler s paper on Rationalization of the Oil Industry reports of which duly appeared in NATURE There are author and subject indexes at the end of each volume which in the latter case might with advantage have been made fuller in view of the technical value of these volumes as standard works of reference

The editing of such a large number of papers dealing with so many different subjects and presented in such diverse ways was however nothing short of a Herculean task and the editors are to be congratulated on the efficient manner in which they have discharged it H B MILNER

Short Reviews

A Short Course in Elementary Meteorology By W H Pick (M O 247) Fourth edition completely revised Pp 143 (London H M Stationery Office 1933) 2*s* 6*d* net

THE material of this book is divided into three parts under the headings general meteorology synoptic meteorology and the upper air the first part dealing with wind temperature humidity and ordinary weather phenomena the second with the modern synoptic weather chart and the systems of forecasting based upon it and the third with the physical structure of the atmosphere from the ground up to the highest levels to which recording instruments have been taken by sounding balloons

The descriptions are generally clear and contain few of the inaccuracies which are so common in most works of this scope The author rightly emphasises in the introductory chapter how important it is for the student to remember always that meteorology is a branch of the wider science of physics It is however from the point of view of physics that objection may be made to some of the author s statements for example when he discusses (pp 16–17) the diurnal range of temperature on land and on sea he attributes part of the greater magnitude of the former to the action of the principle that a good radiator is also a good absorber but overlooks the fact that it is largely the absorption of radiation of short wave length (visible radiation) that has to be considered during the daytime and that even if it be demonstrable that the solid surface of the earth absorbs such radiation better than does water it does not follow that the land is a better radiator for the much longer wave lengths emitted at night A small error deserves notice in section 102 (p 95) where it is stated that in the northern hemisphere the eye of a tropical cyclone generally moves eastwards As it is the active stage of a cyclone that is being discussed the movement would be nearly always westwards whether in the northern or southern hemisphere for these storms spend a large proportion of their active life within the tropics E V N

Annual Reports on the Progress of Chemistry for 1933 Vol 30 Pp 462 (London The Chemical Society, 1934) 10*s* 6*d*

THE series of reports for 1933 deals with general and physical, inorganic, organic and analytical chemistry, biochemistry, radioactivity and subatomic phenomena, and crystallography, and forms a substantial contribution to the literature of the science As in former years, the plan adopted is to discuss progress in a limited number of special subjects rather than to attempt a comprehensive survey, a task which would indeed be impossible within the accepted limits of space and cost Thus, for example, Mr R P Bell discusses solubility and related phenomena, Mr J H Wolfenden s section on electrochemistry is confined to 'heavy hydrogen', the structure of water, and the mechanism of hydrogen and oxygen electrode processes and in the biochemistry section space is devoted to a review of progress in the biochemistry of bacteria during the past three or four years Analytical chemistry is represented by discussions of the polarographic spectroscopic and magneto optic methods the physical properties of solutions an extended account of electrometric methods and a section on gas analysis Dr A S Russell examines *inter alia*, advances in artificial disintegration and the positive electron, whilst Dr G A R Kon discusses in some detail the considerations which have recently led to the establishment of the main structural outlines of the sterols and bile acids

Among research chemists this series of annual reports is recognised as providing extremely valuable and authoritative surveys, among teachers of chemistry it is regarded as affording the best means of keeping abreast of modern developments Workers in related sciences, although not requiring to make a study of every chapter, will nevertheless find in this book a great deal of valuable information and explanation, some of which may prove of prime significance in their own researches A A E

(1) *Pink Disease (Infantile Acrodynia)* By Dr Ch Rocaz Translated by Dr Ian Jeffreys Wood Pp v+153
(2) *Infantilism* By Dr E Apert Translated by Dr R W B Ellis Pp v+117+4 plates (London Martin Hopkinson, Ltd, 1933) 7*s* 6*d* net each

THE translation into English of these two French monographs provides interesting and valuable additions to medical literature

(1) "Pink Disease' is the title given to Dr I J Wood's translation of "L'Acrodynie Infantile", which is a comprehensive survey of an illness the obscure nature of which is indicated by the numerous names it has received A full historical, clinical and pathological review is given, and the conclusion is reached that the disease is an inflammation of the nervous system closely allied to epidemic encephalitis It is probably extremely rare in Great Britain, but its apparent tendency to occur in small outbreaks makes it important that physicians should have some knowledge of it The long bibliography included provides references for those who wish to make a detailed study of the subject

(2) Infantilism ' describes in detail the many varieties of the well known state of retarded development, and includes a chapter on the less familiar condition of regression after mature development known as Gandy s retrograde infantilism As textbooks of neurology and pediatrics make but scanty reference to these disorders, and offer little or no therapeutic indications, it is significant to find a whole chapter of this book devoted to treatment

Both monographs are particularly well illustrated

The Method and Theory of Ethnology an Essay in Criticism By Paul Radin Pp xv+278 (New York McGraw Hill Book Co, Inc London McGraw Hill Publishing Co, Ltd, 1933) 15*s* net

ETHNOLOGY is defined by Dr Paul Radin as the description of aboriginal culture, and the object of this essay in ethnological criticism is to show how far the various schools of thought fail to attain the object of the study The evolutionary school, of which Tylor is regarded as the founder and the chief exponent as might be expected, is sharply criticised for various reasons, of which the principal is that it regarded the study of primitive peoples as an evolution of culture and also looked upon its material as representing a phase anterior to that of civilised man of to day Hence the theory of survivals Other schools, the diffusionists', the functionalists, and in America the followers of Prof Boas, are alike criticised from the point of view of the author that ethnology is a purely historical science, and that as such it must treat each phase and manifestation of culture as individual

Chemistry and Physics for Botany and Biology Students By Dr E R Spratt Second edition Pp vii+284 (London University Tutorial Press, Ltd, 1933) 3*s* 6*d*

THIS up to date little book is designed, in particular, to include the sections on elementary chemistry and physics in the syllabuses of botany and biology of the Oxford and Cambridge School Certificate examinations, and emphasises the applications of physical and chemical phenomena to plant and animal life The second edition has been revised and extended to deal with magnetism and electricity, light, electrolytic dissociation and hydrogen ion concentration, the structure of the atom and valency

It can be recommended without reserve to students as indicated in its title, and should, in addition, meet the needs of students in general or of classes requiring a sound and inexpensive course in general science N M B

Liquefaction of Helium by an Adiabatic Method without Pre-cooling with Liquid Hydrogen

By Prof P Kapitza, F R S, Royal Society Mond Laboratory, Cambridge

THE methods for the continuous liquefaction of hydrogen and helium at present in use are essentially the same as those originally used by Dewar and Kamerlingh Onnes when these gases were first liquefied These methods are based on the use of the Joule Thomson effect combined with a regenerating heat exchange after the gas has been cooled below its conversion temperature by liquid air or hydrogen Since these processes are essentially non reversible the efficiency of the method is very low for example, Meissner[1] calculates that to produce liquid helium one hundred times more power is required than if the process could be done reversibly The advantages to be gained by using adiabatic expansion for the cooling of liquefying gases have long been realised, but owing to technical difficulties this method has only been used up to the present to liquefy small amounts of gas by a single expansion Thus in 1895, Olszewski was the first to obtain a fog of liquid hydrogen drops by a sudden expansion of compressed hydrogen Recently, Simon[2] has produced appreciable quantities of liquid helium also by a sudden expansion of highly compressed helium

The technical difficulties in constructing an apparatus for continuous liquefaction by adiabatic expansion lie chiefly in the designing of a cooling expansion engine which will work at low temperatures Two principal types of expansion engine can be considered The first is a turbine, but this involves a number of technical difficulties which have not yet been overcome The second type of machine is a reciprocating moving piston expansion engine, this also involves great difficulties chiefly arising from the difficulty of finding a lubricant which will make the piston tight in the cylinder and retain its lubricating properties at the very low temperatures Claude, however, managed to make such an expansion engine which would work at the temperature of liquid air by using the liquefied gas as the lubricant This method, however, does not appear to be practicable for liquefying helium and hydrogen

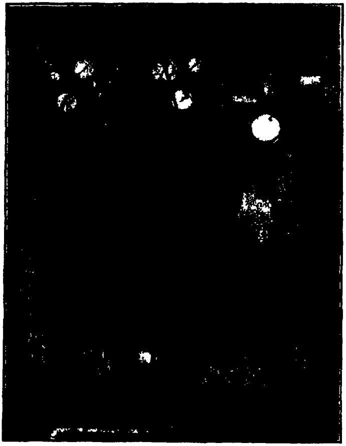
Fig 1 Helium liquefaction apparatus at the Royal Society Mond Laboratory

During the last year, in our laboratory we have been working on the development of a reciprocating expansion engine working on a different principle which does not require any lubrication of the piston at all, and which will work at any temperature The main feature of the method is that the piston is loosely fitted in the cylinder with a definite clearance, and when the gas is introduced into the cylinder at high pressure, it is allowed to escape freely through the gap between the cylinder and the piston The expansion engine is arranged in such a way that the piston moves very rapidly on the expanding stroke, and the expansion takes place in such a small fraction of a second that the amount of gas escaping through the gap is very small and does not appreciably affect the efficiency of the machine

The principal difficulty in constructing such a machine was concerned with the valves in the expansion engine, which had to let in a considerable amount of gas in a small fraction of a second Another difficulty was to find metals with the necessary mechanical properties for use at these low temperatures All these difficulties have now been successfully overcome, and the liquefier is shown in the accompanying photograph (Fig 1)

The expansion engine is placed in the middle of the evacuated cylindrical copper casing, the dimensions of which are 75 cm long and 25 cm diameter The casing also contains heat exchanging spirals and a container of liquid air for the preliminary cooling of the helium Helium is compressed to 25–30 atmospheres and is first cooled to the temperature of liquid air and then cooled by the expansion engine and regenerating spiral to about 8° K , the final liquefaction is produced by making use of the Joule Thomson effect This combination proves to be the most efficient method of liquefaction The liquid helium is drawn off from the bottom of the liquefier by means of a tap

Following the preliminary cooling to the temperature of liquid nitrogen, the liquefier starts after 45 minutes to liquefy helium at a rate of 1 litre per hour consuming about 3 litres of liquid air per litre of liquid helium This output we hope will shortly be increased, but even now it compares very favourably with the original method of making liquid helium in which, according to Meissner (*loc cit*), the consumption is 6 litres of liquid air plus 5 litres of liquid hydrogen per litre of liquid helium It is also evidently a considerable advantage to be able to dispense with liquid hydrogen as a preliminary cooling agent Theoretically it would be possible in our case also to dispense with liquid air but the size of the liquefier would then be impracticably large Using liquid hydrogen as a cooling agent the output of the liquefier could be increased about six times

The same liquefier has also been used for liquefying hydrogen which was passed through a special circuit under a pressure of a few atmospheres

A detailed description of the apparatus will shortly be published elsewhere

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[1] Handbuch der Physik Geiger and Scheel vol 11 p 328

[2] *Z Phys* 81 816 1933

Science and the Royal Academy

IF the art of the painter were to begin and end in mere representation, the coloured photograph would completely satisfy most people Indeed, science, by the invention of the stereoscope, has furnished a means of actual representation in three dimensions which far surpasses in this respect even the greatest paintings that exist It is a commonplace to hear, in any gallery expressions of approval or otherwise based mainly upon such considerations

Sir Joshua Reynolds, in his sixth discourse before the Royal Academy, says When the arts were in their infancy, the power of merely drawing the likeness of any object was considered one of its greatest efforts The common people, ignorant of the principles of art, talk the same language even to this day " On the other hand Carlyle, quoting Goethe, points out that 'In every object there is inexhaustible meaning the eye sees in it what the eye brings means of seeing The colour arrangement style or texture, design and rhythm can only fully appeal to those who have given the matter some thought, and who realise that Art is Nature expressed through a personality

Yet there must be rules underlying the making of a picture which give to it those fundamental qualities that ensure its survival through the ages Although science has given the painter a wider range of reliable pigments, and the oils and mediums used by him are more refined and less liable to change, it is interesting to notice that this craft still employs identically the same kind of tools and methods that have been in use for centuries The development of machinery, the vast accumulation of knowledge in all branches of human activity, the great advances in chemistry and physics, leave the artist undisturbed with his simple appliances He still works in surroundings very similar to those that could have been found in the studios of Michael Angelo or Titian The artist is probably unique in this and acquires therefrom a peculiar position in the scheme of things , often being regarded by the ignorant as a kind of magician, by the intelligentsia as a species of poet and sometimes by men of science as an overrated member of society who seems in fact to have contributed nothing to the accumulations of unsorted knowledge

A possible remedy for this state of affairs lies with the artists themselves The old masters have left us pictures of the alchemist in his laboratory Present day artists have missed a great opportunity in not attempting to represent something of the atmosphere in which modern scientific experiments are frequently conducted Surely there is wide scope here for artistic adventure It is not merely a question of depicting some distinguished individual before a background of scientific apparatus The figures some in action and others eagerly note taking, should be subsidiary to the general plan There is often great beauty of colour and composition to be found—especially in a physics laboratory—where some important work is afoot and being carried through, in dim light stabbed only by beams reflected from the instruments

The one hundred and sixty sixth annual exhibition of the Royal Academy, which was opened to the public on May 7, includes the famous bust of Prof Einstein (1593) by Mr Jacob Epstein This has been purchased for the nation under the terms of the Chantrey Bequest There is also a good portrait of Sir Robert Mond (146), painted by Mr F O Salisbury, and an excellent picture of Prof John Walton (with a microscope at his elbow) (248) by Mr W O Hutchison An attempt to portray a situation of scientific interest may be seen in No 167, entitled "The Wilson Observer, 1933", by Winifred M Abram The portrait of Sir Almroth Wright (28) by Mr Gerald F Kelly exhibits a quality which will please all who are satisfied with photographic accuracy Other portraits likely to interest readers of NATURE are those of Major C H Douglas, consulting engineer and economist (3), by Mr Augustus E John, R.A., Prof H M Macdonald, professor of mathematics in the University of Aberdeen (254), by Mr R G Eves, Sir George Buckston Browne (1096), a miniature by Mr P Buckman Since the portraits exhibited at the Academy are often of especial interest, a small additional index to them might with advantage be included in the catalogue

The work of Mr Terrick Williams, R A, entitled 'Sun and Mist, Mousehole" (19), is interesting as representing some beautiful changes in appearances due to the dispersion of light through an atmosphere laden with warm vapour

One outstanding feature of this year's exhibition is the large scale model (1 in to 4 ft) of the Metropolitan Cathedral of Liverpool, made by Mr John B Thorp, to the designs of Sir Edwin Lutyens, R A Finally, we may direct attention to the remarkable metallic sheen upon the herald's coat in the portrait of Sir Gerald Wollaston, Garter Principal King of Arms (237) by Mr Harold Knight The brilliant lustre of polished gold is perfectly imitated, merely by the skilful use of suitable pigments

Dr. Boys on Gas Calorimetry

THE nineteenth Guthrie lecture of the Physical Society was delivered on May 4 by Dr C V Boys, one of the Gas Referees, who took as his subject 'My Recent Progress in Gas Calorimetry" Lord Rayleigh presided

After referring to his very close association with Prof Guthrie Dr Boys remarked that the making of specious scientific surmises unsupported by experiment, however amusing it may be as a pastime or however loudly it may be advertised, does nothing to advance the certain knowledge of the world the acid test of experiment is essential So will you who in years to come will have the management of this Society in your hands, accept this as a solemn message from the dead If you would be true to the ideals of Guthrie, you will seek for a Guthrie lecturer from among those who have done things rather than from those who have merely talked

Proceeding Dr Boys stated that he had not been entirely satisfied with the gas calorimeters he had already invented, but now, as the result of work extending over the last nine years, he had designed a calorimeter which gave him complete satisfaction The essentials of a water flow calorimeter for measuring the heating value of gas comprise a stream of water to be heated by the combustion of a supply of gas, and means for indicating or recording the resulting rise of temperature of the water stream As the volume of a given mass of gas depends on its temperature and pressure, it is clear that means must be provided either to correct such volume to standard conditions of temperature and pressure, or alternatively to ensure that water shall flow through the calorimeter at a rate proportional to the uncorrected density of the gas, that is, inversely proportional to the volume at the time of a standard volume of gas

In his previous recording calorimeter, Dr Boys utilised the first of these alternatives, in the present instrument (Fig 1) the latter alternative is adopted The appropriate hyperbolic relation is realised practically by a device which ensures that the depth of water in the vessel *A* is proportional to the density of the gas, and that water is picked up from this vessel and delivered to the calorimeter *F* in this same proportion The device comprises (1) the closed burette tube, *D*, containing air or other gas, carried on the radial arm, *C*, and immersed at its lower open end in a vessel containing mercury, (2) four rotating scoops carried on arms for collecting distilled water from the lower vessel *B* and delivering it to the upper vessel, *A*, these pick up rather more than is required for the calorimeter water, (3) a pair of rotating scoops and delivery vessels, of which one is shown at *E* for collecting the appropriate volume of water from *A* and delivering same to the calorimeter proper, *F* The excess of water escapes from a siphon carried by the arm *C*, thus maintaining the required level The motive power for driving the mechanism is derived via a Meccano' chain from the small electric motor shown at *H* The water flow system requires the addition of only about 1 gallon of water per annum to replace that lost by evaporation

The gas pump, *G*, for supplying gas to the calorimeter, incorporates a number of novel features Hitherto, the calorific value of gas supplied for towns' use has been measured with reference to a volume of gas saturated with water vapour, at atmospheric temperature Within recent years, there has been an increasing tendency on the part of gas companies to supply dried gas, that is, gas from which a very considerable proportion of the water vapour ordinarily present has been removed In order that the calorific value of such, or any other, gas shall be measured with reference to its actual water vapour content, whether saturated or unsaturated, the gas pump, *G*, uses mercury as confining liquid Briefly, the pump comprises an inner cylinder having six longitudinal compartments accurately reamed out, and rotating within an outer casing Appropriate inlet and outlet ports are provided for each compartment The same small electric motor *H* driving the water supply device rotates the inner drum of the gas pump and causes gas to be delivered to the calorimeter proper *F* at a constant rate of ½ cub ft of gas per hour The volume of gas is accurately determined from the known dimensions of the pump Water levelling which is an essential and troublesome operation with all existing forms of wet meter in order that the gas volume may be accurately known is no longer necessary

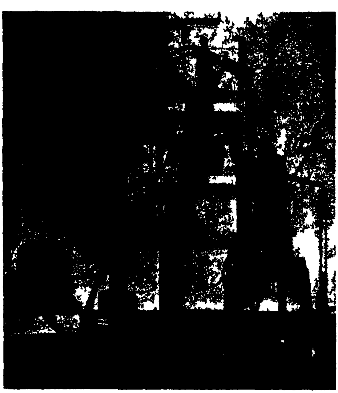

Fig 1 Dr Boys s new gas calorimeter

The calorimeter *F* is of very small thermal capacity so that a reading of outlet water temperature steady to within about 0·01° C is attained in about 15 minutes and this despite the fact that with the calorimeter as at present constructed the flow of water through the calorimeter is intermittent in character Later if found preferable the water flow will be made continuous The gas burns at the end of a small tube made of Pyrex glass which is carried by the arrangement including a Watt parallel motion device shown at *J* The tubes of this parallel motion device can be used for supplying gas and oxygen to the burner if desired The constructional materials used in the calorimeter comprise ordinary glass for the combustion chamber a Pyrex glass burner tube and brass and German silver the latter being protected by a coating of special bakelite varnish which very effectually prevents corrosion of the base metal by the products of combustion The water flowing through the calorimeter suffers no deterioration owing to its passage and is re circulated The rise of temperature of the water is a measure of the calorific value of the gas supply and can be observed by thermometers inserted respectively in the inlet and outlet water or can be recorded by thermometers preferably of the electrical type connected with an electric recorder

Concluding his remarks Dr Boys stated that he had carried out the whole of the work single handed and had constructed the whole of the apparatus himself For sixty years the Gas Referees have been men of high scientific distinction My predecessors were Sir Arthur Rücker and Prof Tyndall and my colleagues and their predecessors were of equal standing This has always been considered necessary because of the technical difficulties of the questions which they had to decide The Gas Referees have been in the position of judges between the gas maker and the gas consumer Though provision for appeal on their decisions is available no appeal in all that time has ever been made and heard Now the Board of Trade is knocking at the door of Parliament to replace the Gas Referees by the cumbersome machinery of the Civil Service

Dr Charles Carpenter president of the South Metropolitan Gas Co expressed his very high appreciation of the work done for the gas industry by the Gas Referees and stated that he was unable to understand how the Government is being so misguided as to recommend the abolition of these posts

J S G T

Obituary

Prof A B Macallum F R S

PROF A B MACALLUM who died on April 5 at London Ontario in his seventy sixth year may be regarded as the pioneer of general physiology in Canada Educated at the University of Toronto he received his training in physiology under Newell Martin in the then newly organised Johns Hopkins University Returning to his *alma mater* in 1887 as lecturer in physiology on the staff of biology under Ramsay Wright he devoted himself to investigations bearing on the interpretation of microchemical reactions

Macallum s first paper on the demonstration of iron in chromatin was published in 1891 (*Proc Roy Soc* 50 277) and it was followed two years later by a second one (*J Physiol* 26 268 1893) dealing with the path of absorption of this element from the alimentary canal Methods were then tested and elaborated for the micro-chemical demonstration in cells and tissues of other elements, especially phosphorus, potassium, calcium and chlorine He showed (*Proc Roy Soc* , B, 76, 217 , 1905) that the colour reaction which tissues give under the influence of light when impregnated with nitrate of silver is not due, as had been supposed, to protein itself but to halogens, so that this staining method could be used for determining the distribution of chlorides in various cytological elements

Being a keen student of the then rapidly expanding knowledge of physical chemistry, Macallum saw the possibility of using micro-chemical reactions to investigate the position in the cell of adsorbed ions and of thereby determining the extent to which this might be influenced by surface tension Realising that the chloride reaction was independable for this purpose, because of slow penetration of the reagent, he devised a method by which potassium can be identified microchemically through its precipitation with hexanitrite of cobalt and sodium (*J Physiol* , 32, 95 , 1905) He showed that when proper precautions are taken, the reagent penetrates the cell rapidly and that the position of the yellowish compound which it forms with potassium can be revealed by subsequent treatment with ammonium sulphide

A thorough investigation, extending over several years, was then made of the distribution of potassium in plant and animal cells, and it was found that the element is concentrated in regions of the cell in a manner to suggest that alterations in surface tension are responsible In a review of these researches published in 1911 in *Ergebnisse der Physiologie*, there is a full discussion of the hypothesis that the properties of division and movement in cells, as well as of secretion and absorption, can be attributed in part, at least, to surface tension phenomena In a later discussion of his results (1913) (Presidential Address, Soc of Biol Chem), Macallum advanced the view that the chief factor in muscular contraction "is the attraction between the molecules constituting the superficial film of a sarcostyle and forming an interface with the sarcoplasm surrounding the sarcostyle" This attraction, which is the cause of the surface tension, is not equal throughout the doubly refracting discs, as is shown by the fact that potassium salts are localised at the ends of the longitudinal axis, indicating, according to the Gibbs Thomson principle, that the surface tension is lower here than on the lateral surfaces During contraction, the discs tend to become spherical because the surface tension of the lateral surfaces becomes less Speculations follow concerning the relationship of the breakdown of the lactic acid precursor to these changes in surface tension, and the paper is interesting reading in the light of the more recent researches in this field

Macallum also made numerous observations by chemical methods of the percentage amounts of inorganic ions in the tissues and body fluids of various animals He showed that when regard is paid to the relative proportions of sodium, potassium and calcium, rather than to the absolute concentrations of these ions, there is a striking resemblance between the composition of the ocean and the inorganic composition of the blood plasma of mammals His first paper in this field appeared in 1903 (on "The Inorganic Composition of the Medusæ", *J Physiol* , 29) and the conclusions there drawn are sustained in a second one published in 1910 ("The Inorganic Composition of the Blood of Vertebrates and Invertebrates and its Origin", *Proc Roy Soc*) in which there is a discussion of the relationship of the development of the kidneys to the inorganic composition of the blood plasma of various marine invertebrates and vertebrates In this paper Macallum points out that the establishment of a constant internal medium was the first step in the evolution of vertebrates from an invertebrate form and advances the view that the kidney was essentially the first typically vertebrate organ

Throughout all his investigations, Macallum maintained a broad philosophical outlook and his thorough knowledge of biology and indeed of natural science in general enabled him to find various applications for the results of his laboratory investigations As examples may be mentioned papers dealing with the origin of life on the globe (read before the Royal Canadian Institute about the year 1903) and the physical and chemical factors in heredity (address as president of the Biological Section of the Royal Society of Canada in 1910)

No account of Macallum's career would be complete that did not refer to his painstaking work from 1916 until 1921 as the first administrative chairman of the Advisory Council for Scientific and Industrial Research of Canada His influence on the development of scientific research in the Dominion has been very great, partly through his active participation in the work of the Royal Canadian Institute and the Royal Society of Canada, and partly through his association first with the University of Toronto and latterly with that of McGill in Montreal

Macallum was a man of imposing presence and forceful character, and it will be long before he is forgotten in Canadian scientific circles

J J R M

DR E W WASHBURN

DR EDWARD WIGHT WASHBURN, who died on February 6 at the age of fifty-two years, was the chief of the Division of Chemistry of the U S Bureau of Standards at Washington He was well-known to a wide circle as a physical chemist of distinction and the author of an "Introduction to the Principles of Physical Chemistry"

Washburn was a graduate of the Massachusetts Institute of Technology, where he was a pioneer in the study of the hydration of the ions in aqueous electrolytes From 1908 until 1922 he held appointments in physical chemistry and then in ceramic engineering at the University of Illinois, where he produced a long series of scientific and technical papers Then, during a period of four years, he undertook the Herculean task of editing the 'International Critical Tables", a task which was rendered supremely difficult by the fact that it had to be undertaken *de novo* instead of undergoing a progressive development The completed tables, which have recently been made much more accessible and easy to use by the addition of a new index volume, will remain as a monument to Washburn's patience and skill, and are likely for many years to serve as a foundation, to which successive volumes of the "Annual Tables may be added in order to maintain the up to date character of the whole edifice

When appointed to the Bureau of Standards in 1926, Washburn undertook a wide programme of investigation and research, from which two items may be selected for comment The first was the remarkable achievement of preparing crystals of rubber, by distillation under extreme conditions of low pressure and short distance, in which Washburn was keenly interested when I visited him at the Bureau of Standards in 1930 The second, which will perhaps be appreciated more widely than any other feature of his career was his discovery in January 1931 of the fractionation of light and heavy water by the process of electrolysis The separation of isotopes on a practical scale marks the beginning of a new period in chemistry, and, since Washburn's method of separation is already being developed as a manufacturing process, his name will long be remembered as the originator of this new period

T M LOWRY

DR L R FARNELL

WE regret to record the death of Dr L R Farnell, formerly rector of Exeter College, Oxford, and the well known authority on the religious cults of ancient Greece, which took place at Parkstone, Dorset, on March 28

Lewis Richard Farnell attained the age of seventy-eight years on January 19 last, having been born at Salisbury in 1856 The second son of John Wilson Farnell, he was educated at the City of London School, of which Dr Evelyn Abbott was then headmaster, and at Exeter College, Oxford, where he won an open classical scholarship Practically the whole of the rest of his life was devoted to the service of his College and University Two years after taking his degree in 1878, with first-class honours in both Classical Moderations and *Literæ Humaniores*, he was elected to a fellowship of his College He then studied classical archæology in Germany and travelled in Greece and Asia Minor, returning to Oxford to serve Exeter as tutor, sub rector, senior tutor and dean, and from 1914 until 1928 as rector, in which office he succeeded the late Dr W W Jackson

His studies in classical archæology, more especially of the attributes of the gods as represented in art, led Farnell to the comparative study of Greek religious cults He rapidly attained a high reputation as an interpreter of obscure passages in Greek literature in the light of his research His greatest achievement, however, was his monumental work "The Cults of the Greek States" in five volumes, which appeared between 1896 and 1909, with a supplemental volume on hero cults, published in 1921 In this work Farnell showed a mastery of detail which was equal to, if it did not surpass that of the best German scholarship of the day combined with an unusually wide knowledge of comparative material His contribution to the study of Greek culture is original in conception, fundamental and epoch making

Farnell was also the author of a number of smaller works, dealing with the religions of Greece and the ancient East and with comparative religion, in which he showed a great gift of lucid, semi popular exposition, combined with sound scholarship He was a frequent and valued contributor to the learned periodicals concerned with his special studies

In 1901 Farnell was one of the first to receive the newly instituted degree of D Litt of his University He was University lecturer in classical archæology from 1905 until 1914, the first Wilde lecturer in natural and comparative religion, Hibbert lecturer in 1911, and Gifford lecturer in 1919 He served as Vice Chancellor of the University in 1920–1923 If he required a high standard from his pupils in conduct, industry and scholarship, his whole life and work afforded them an admirable example

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DR ALBIN STOCKÝ, professor of archæology at Prague died on April 18 at the age of fifty eight years He was the author of numerous publications dealing with Bohemia in the Stone and Bronze Ages He had served on various archæological commissions and had given valuable assistance to museums in connexion with the identification of objects dating from prehistoric times

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WE regret to announce the following deaths

Mr Henry S Hall, formerly head of the military and engineering side at Clifton College, author of many well known textbooks of mathematics, on May 3, aged eighty-five years

Mr Carl Olaf Lundholm, technical adviser to the Nobel Trust in 1909–14, a pioneer in the manufacture of explosives, on May 8, aged eighty-four years

Dr J P van der Stok, director of the Section of Oceanography and Maritime Meteorology at the de Bilt Meteorological Institute, near Utrecht, in 1899–1923, formerly director of the Magnetic and Meteorological Observatory, Batavia, on March 29, aged eighty-three years

News and Views

Royal Society Elections

AT the meeting of the Royal Society held on May 3, the candidates whose names were given in NATURE of March 10, p. 352, as having been selected by the Council for fellowship of the Society, were duly elected. In addition, two foreign members were elected, namely, Prof. H. L. Lebesgue, of Paris, the discoverer of 'Lebesgue integration', and Prof. O. Warburg, of the Kaiser Wilhelm Institut für Zellphysiologie, Berlin-Dahlem, who is known for his work on cellular metabolism and respiration.

Prof. Henri-Léon Lebesgue, For. Mem. R.S.

HENRI LÉON LEBESGUE was born in 1875 at Beauvais, and after studying at the École Normale Supérieure, taught from 1899 until 1902 in the Lycée at Nancy, where he wrote his famous thèse de Doctorat 'Intégrale longueur, aire', which was published in the *Annali di Matematica*, in 1902. After holding academic posts at Rennes and Poitiers, he was appointed in 1910 lecturer at the Faculty of Sciences of Paris, in 1921 professor of mathematics at the Collège de France, and in 1922 a member of the Academy of Sciences. Prof. Lebesgue's reputation was first made by his definitions of the functional operations of integration and derivation, which are of such generality that they may be applied to classes of functions vastly more extensive than the restricted classes to which earlier definitions had been applicable. It was Cauchy who first replaced the geometrical idea of an integral, as an area, by a precise arithmetical definition, regarding it as the limit of a sum of elements $f(x) \Delta x$ when Δx tends to zero; and on this basis he proved theorems of existence and uniqueness. Riemann generalised Cauchy's conception by extending it to certain functions which were discontinuous at points forming sets dense everywhere; but the functions integrable in Riemann's sense are still a limited class.

IN order to obtain a more general definition, Lebesgue first devised a theory of the 'measure' of a set of points, which was a great improvement on the theory of 'content' previously given by Cantor, namely, that the content of the sum of two sets is not in general the sum of their contents, whereas the measure of the sum of two mutually exclusive sets is always the sum of their measures. He then departed from the procedure of Cauchy and Riemann for defining $\int f(x)dx$, by dividing the range of variation of $f(x)$ into intervals (as contrasted with dividing the range of variation of x into intervals), and considering the measures of the sets of points belonging to these intervals, whence a definition of the integral naturally follows. Lebesgue's definitions of integration and derivation have led to developments of far-reaching importance in the theories of Fourier series and other trigonometric series, of singular integrals, integral equations, Dirichlet's problem, the calculus of variations, functional operations, and the properties of analytic functions in the neighbourhood of their singularities.

Prof. O. Warburg, For. Mem. R.S.

PROF. OTTO WARBURG is well known for his very important work on metabolism and respiration in cells. In this work he made extensive use of the manometric technique, which he greatly developed. This method was applied by him and the members of his school to a great variety of biological problems with conspicuous success. By using very thin slices of animal tissues suspended in serum, precise measurements of respiration and other metabolic processes could be made under approximately physiological conditions. By this means he discovered an important difference between the metabolism of normal tissues and that of rapidly proliferating tissues such as tumours, namely, the fact that the latter show a high aerobic glycolysis. By the study of the inhibitory effect of certain specific poisons, such as cyanides and carbon monoxide, on respiration, he showed the important rôle played by catalytic compounds of iron. On studying the effect of light of different wave-lengths on cells poisoned by carbon monoxide, a photochemical absorption spectrum was obtained which was found to be very similar to that of a hæmatin compound. In this way he showed the importance of hæmatin compounds in cell respiration. In the analysis of these effects he displayed remarkable technical genius. In addition to this hæmatin system (known as the respiratory enzyme), Prof. Warburg has recently discovered another important intracellular system involving a different type of catalytic pigment, belonging to the class now known as flavines. Prof. Warburg is also well known for his fine work on photosynthesis.

Bicentenary of Stahl (1660–1734)

Two hundred years ago, on May 14, 1734, Georg Ernst Stahl, the celebrated German physician and chemist, died at Berlin at seventy-three years of age. For many years he had been physician to Frederick I, King of Prussia, and he was widely known for his original views and for his numerous writings. He wrote, edited or superintended no fewer than 250 works. Born at Anspach, Bavaria, on October 21, 1660, at a time when Germany was just recovering from the terrible effects of the Thirty Years War, he studied medicine at Jena; at the age of twenty-seven years became physician to the Duke of Weimar and six years later was appointed professor of medicine, anatomy and chemistry in the newly founded University of Halle. He taught there for twenty-two years (1693–1716), and it was during that time he enunciated the doctrines of vitalism and animism and the theory of phlogiston, the latter a generalisation which did much to make chemistry a science. "The doctrine of phlogiston," says Thorpe, "was embraced by nearly all Stahl's German contemporaries, notably by Marggraf, Neumann, Eller and Pott. It spread into Sweden, and was accepted by Bergmann and Scheele; into France, where it was taught by Duhamel, Rouelle and Macquer; and into Great Britain, where its most influential supporters were Priestley and Cavendish It continued to be the orthodox faith until the last quarter of the eighteenth century, when, after the discovery of oxygen, it was overturned by Lavoisier "

Refrigeration and its Applications

FOR the first of the series of Research and Development Lectures arranged under the auspices of the British Science Guild and delivered at the Royal Institution, Sir William Bragg, on May 2 took as his subject 'Refrigeration" This he pointed out is of great importance to Great Britain, which imports an immense amount of meat, fish, butter and fruit, many hundreds of shiploads of which are received every year The principles underlying refrigeration are comparatively simple, but their application on a commercial scale has involved much research such as is being carried out at Cambridge, the National Physical Laboratory, East Malling and elsewhere Historically, the subject of heat and cold goes back to the early days of the Royal Society, and Hooke's views on fluidity are of much interest In the eighteenth century, the theory of caloric held sway, but it was through the work of Rumford, Davy, Mayer and Joule that it was shown that heat is, in the phrase of Tyndall, a mode of motion, and to day it can be shown that the molecules of substances are all in motion, the rapidity of which is increased by heat and decreased with cold All the phenomena of expansion, compression and evaporation, which are utilised in refrigerating machines, are explained by this theory Throughout the lecture, each step was illustrated by experiments in which billiard balls, bicycle pumps and liquid air played as important a part as thermo couples and galvanometers A singularly beautiful demonstration of the formation of vapour and clouds was given by pouring liquid air on to the surface of warm water lying in a large shallow pan Liquid air was used also to show the alteration in the properties of substances when really cold, rubber becoming brittle and a bell of lead giving a metallic note when cooled in it Sir William referred to the refrigeration exhibition now being held at the Science Museum, and on behalf of the director of the Museum invited all those in the audience to visit it

Electrical Phenomena at Very Low Temperatures

PROF J C McLENNAN gave the twenty fifth Kelvin Lecture before the Institution of Electrical Engineers on April 26, taking as his subject 'Electrical Phenomena at Very Low Temperatures" In 1823 Faraday succeeded in liquefying chlorine and afterwards succeeded in liquefying many other gases, but he failed to liquefy oxygen, nitrogen and hydrogen as he was unable to obtain the requisite low temperature At the end of the War, a large stock of helium was available in Toronto, and this gas was successfully liquefied in 1923, a century after Faraday's experiment with chlorine By evaporating liquid helium and thus reaching an absolute temperature of 0 7° K , Keesom of Leyden successfully solidified this element in February 1932. The liquid was subjected to a pressure of 175 atmospheres and surrounded by rapidly evaporating liquid helium The reason why liquid oxygen, hydrogen and helium are very good insulators is probably because the electrons are closely bound to the nuclei In 1911, Kamerlingh Onnes found that the resistance of mercury vanishes suddenly at 4 2° K and that some other metals behave similarly at definite low temperatures Most metals show no trace of this supraconductivity even when great pains are taken to ensure their purity Certain alloys have been found to become supraconductive This supraconductivity can be destroyed by placing them in a magnetic field The lower the temperature the greater the magnetising force necessary to destroy the supraconductivity By suddenly destroying the magnetic field surrounding a ring of supraconductive metal, a current can be set up in it if its temperature be below the transition point This current is quite independent of the nature of the metal and depends only on the intensity of the original induction It looks as if the results of low temperature research would throw light on the nature of magnetism

The Restrictive Law of Population

IN his Huxley Memorial Lecture under this title, delivered on May 4, Prof Johan Hjort, of the University of Oslo, dealt with a subject which exercised a decisive influence upon the thought of Huxley the question of over population (London Macmillan and Co , Ltd 1s net) Prof Hjort assumes that human society can be studied as a historical group of diverse individuals living in a restricted complex environment, and shows that biology has disclosed the many and various factors which influence the vital processes of the individuals comprising a population and determine the quantity and quality of the population as a whole He defines an optimum population as the minimum number of individuals who can utilise to the full the vital possibilities made available by one or other of those factors Incidentally, he surveys the fishing and whaling industries as examples, and illustrates his point that the conditions in both depend upon the power of regeneration shown by the stock In the case of the whale, technical developments have produced a grave disharmony between the reproductive rate and the death rate, and the problem before the industry is that of defining the optimum catch Restriction of the numbers killed is urgently demanded, but this requires both State intervention and international agreement

ACCORDING to Prof Hjort, the ideal of all social endeavour is the maintenance of the population in a state of permanent equilibrium under conditions of life which are optimal For the achievement of this ideal, society must undertake vast and prolonged biological experimentation Through biology there has come an emancipation from mental chaos and from the belief that human life is governed by irrational chance Biology has shown that over-population, which inevitably arises in certain given natural conditions, is not due to a superficial turmoil of moods and sentiment, but to the operation of natural laws. To-day society has both the knowledge and the power to solve, in its own ways, the problem of population. If there be the possibility of enlargement of the means of subsistence, of renewed expansion, then this should be completely explored; but, if such expansion is impossible, then the aim of society must be to ascertain the limits in which an optimum population can enjoy the maximum of liberty. In both tasks the method must be that of the social experiment. Though Prof. Hjort mainly restricts himself to a discussion of the method of research and experiment in its application to social problems, he does not avoid the conclusion that an economically re-united Europe would afford conditions for a new emancipation, for a recovery of the freedom that the War destroyed. For, he holds, this would bring peace, and peace amongst men is not a natural state of things; it does not make itself but must be made.

Representation of Science on Government Commissions

As announced last week in this column, the Postmaster General is about to set up a committee to consider the development of television and to advise on the conditions under which any public television service should be provided. It is understood that the personnel of the committee is to consist of representatives of the Post Office, the British Broadcasting Corporation and the Department of Scientific and Industrial Research. A committee so constituted, presuming that some of the members have practical knowledge of the problems involved in television, would command that measure of public confidence which is necessary if its deliberations are to find general acceptance; and it would be an advance on many Commissions and committees appointed by the Government in this respect. For reasons which it is difficult to understand, there has been a lamentable tendency on the part of Ministers to pass over scientific men in setting up Royal Commissions, committees, and departmental committees even when matters in which scientific and technical issues are involved.

It is to be hoped that the constitution of the television committee is a sign that the Governmental mind is being quickened in this respect. Time and again we have urged that no body set up to consider any subject with scientific or technical ramifications can be adequate or complete unless it includes scientific workers or technicians in its personnel. The Parliamentary Science Committee—a body representing the British Science Guild, the Association of Scientific Workers, and a number of learned societies—has also taken up the matter, urging the Prime Minister to insist on his colleagues observing this principle. Some fifteen months ago the Postmaster General appointed a Post Office Advisory Committee. If this body is to be of real service it will, presumably, have to advise on technical matters such as telephony and telegraphy. Yet no one with scientific or technical qualifications was appointed amongst a numerous membership. There is now a vacancy occasioned by the death of the Hon. Mary Pickford, thus affording an opportunity of rectifying this state of affairs.

Scientific Method and Politics

The first instalment of a tabular analysis of various social and economic systems, in the form of answers to a questionnaire prepared by the Engineers' Study Group on Economics (Nature, 132, 635, Oct. 21, 1933) is to appear in the forthcoming issue of *Progress*, the organ of the Association of Scientific Workers. The Study Group, apart from research investigations, arranges for discussions on questions of the moment, at which those engaged in any branch of scientific work are welcomed. On May 16 Mr. Harold Macmillan, M.P., will address the Group on "Reconstruction". The meeting will be at 7.45 for 8 p.m. at Denison Hall, 296 Vauxhall Bridge Road, Victoria, and Sir Richard Gregory will take the chair. Tickets may be obtained from the honorary secretary of the Group, Col. P. Johnson, Gunnersbury House, Hounslow, Middlesex.

The interest which scientific workers are beginning to show in social and economic questions is not restricted to Great Britain. In France there are several active groups. The Centre Polytechnicien d'Etudes Economiques (12 rue de Poitiers, Paris; president, M. Gerard Bardet) consists mainly of former students of the Ecole Polytechnique, one of the best known engineering colleges in France, and is now in its third year of existence. Another, the Centre d'Études Économiques de l'Alimentation (39 boulevard de Sebastopol, Paris; president, M. André Roussel) was formed by the fusion of three pre-existing groups drawn from the Ecole Polytechnique, Ecole des Centraux and the Institut Agronomique. Both organisations publish bulletins regularly, giving the results of their studies on economics and production and distribution of foodstuffs.

Unemployment and Poverty in India

In a recent article in the *Karachi Daily Gazette*, Capt. Petavel, formerly lecturer on the poverty problem at the University of Calcutta, strongly advocates the formation of co-operative colonies as a solution of the problems of unemployment and poverty in India. He suggests that the colonies should be open not only to those who have merely their labour to offer, but also to those who would contribute capital, land or equipment. All would be co-operators in their way, and would have a share of the products. The workers' remuneration would be mainly in kind, but part might be in money. This would enable the more ambitious to save, and in time to launch out on any small undertaking they might fancy. If they failed, they could return to the colony, which would thus provide opportunity with security. As the colonies developed, they could adopt a system of exchange tickets redeemable in the produce of the colony. Thus it is claimed purchasing power would always be commensurate with productive power. People could always get work in the colony, because they would get a ticket to take away what they had produced. To reinforce his argument, the author refers to the Swiss Labour Colony at Witzwil and that at Llano in Louisiana

In the former, even people classed as 'unemployables' have been made self supporting In India he suggests a start could most easily be made with an educational co-operative colony in which young persons could work and receive their education Elderly persons might also be included to act as leaders, or to work in departments of their own In order to start a fund for experiment on the lines advocated by Capt Petavel, the Mayor of Karachi has announced that he will give Rs 5,000 and 50 acres of good land near Karachi

Re-equipment of Collieries and Steelworks

IN the supplement to the *Daily Telegraph* of March 19, Dr A H Railing says that the need for the reorganisation of certain of the basic industries of Great Britain is urgent As a result of recent applications of scientific knowledge, great advances have been made in developing new plant for the economic mining of coal and the manufacture of iron and steel products In recent years the grouping of collieries makes it possible to use large turbo machines and thus considerably lowers the cost of generating electric power This solution of the problem of the handling and transport of coal will contribute greatly to the economic success of the undertaking A colliery equipped with a modern coal cleaning installation can command higher prices for its output Loss and waste due to the breakage of coal can now be reduced to a minimum by using anti breakage devices By grouping together iron and steel works it would be possible to utilise the by product gases of the iron and steel industry An installation of large turbo generator units in such a station would enable it to have a thermal efficiency as high as that obtained in the largest modern power station The by product gases from the industry would in this way acquire the same heat value as the coal used in coal fired power stations Many of the rolling mills in Great Britain have been installed for very long periods and their retention in service militates against securing the high quality of product demanded to day An electrically driven rolling mill of modern design can be regarded in the light of a precision tool, capable of an output of material possessing the highest degree of accuracy obtainable in rolling practice The electric furnace also opens out great possibilities One of the valuable properties of the high frequency electric furnace is that, when operating, it gives rise to an automatic stirring action which secures a uniform product

Street Traffic Signals, 1868 1934

IN 1868 the City of Westminster introduced a method of mechanical signalling to help the police to control the traffic A semaphore, having a red and green gas lamp for night use, was employed, but unfortunately an explosion put an abrupt end to this experiment Early in this century, road signals similar to railway signals were used for controlling a few tramways and also the traffic on Tower Bridge So far back as 1918, colour light signals were used to control street traffic in New York The Siemens and General Electric Railway Signal Co (S G E) installed the first modern British traffic signal at a busy road junction in Wolverhampton in 1926 The most recent development of the vehicle actuated signals is the Autoflex' system of the S G E , a full description of which is given in the Engineering Supplement of the *Siemens Magazine* for April It was first brought into use in November 1933 and there are now several installations giving very satisfactory service In this system vehicles approaching a road junction pass over pneumatic detector mats installed in the paths of the various traffic streams and so notify their movements to an electrically operated controller The mats are equivalent to the eyes and ears of a traffic policeman If vehicles leave the intersection on the wrong side of the road the mats are insensitive The top of the mat is rounded and projects slightly above the road level presenting a good striking face, so that it is not possible for high speed vehicles or caterpillar tractors to ride over it without registering If no suitable gap occurs within a predetermined time, the continuous stream is arbitrarily interrupted and the right of way transferred There is no necessity for long amber periods since signal changes take place only when the intersection is clear , two or three seconds are generally sufficient The power required for a controller is only about 30 watts, which is less than that required by an ordinary lamp

Crystalline Structure and Failure of Metals

THE eighth Edgar Marburg lecture of the American Society for Testing Materials was delivered by Dr H J Gough, his subject being Crystalline Structure in Relation to Failure of Metals—especially by Fatigue" Dr Gough dealt almost exclusively with the results of X ray examination of metals and the paper contains what is probably the fullest résumé yet given of the subject Some indication of the ground traversed will be obtained from the fact that the bibliography contains no less than 175 separate references Starting off with a general discussion of the nature of the atomic bond and of the structure of solids in connexion with the basic problem of failure under stress, the methods of preparation of single crystals of metals and crystal structure as revealed by X ray investigation, Dr Gough then proceeded to consider more specifically the distortion of single metallic crystals under simple static stresses, the influence of the crystal boundary upon strength and distortion and the effects of cold working upon single crystals and multicrystalline aggregates Coming to the subject of failure under fatigue' conditions, Dr Gough dealt with metals crystallising in the face centred cubic, in the close-packed hexagonal (discussing incidentally the twinning of zinc), in the body centred cubic, and in the face centred rhombohedral lattices Finally, he considered the behaviour of single crystals as compared with that of multicrystalline metals Dr Gough's conclusions are not yet everywhere accepted, but whatever the individual opinions of readers of the lecture may be, it will be universally welcomed as providing in a readily accessible form, an almost ideal summary of work dispersed throughout a multitude of different publications.

Aerial Surveys for Town Planning

THE urgent necessity for modern town plans required under the Town Planning Act has raised the possibility of meeting the demand by aerial survey In most cases, less than two years remain for the completion of these plans The Ordnance Survey at its existing strength cannot hope to meet this demand A scheme outlined in the *Times* of May 5, however, promises to meet the situation, and the Ordnance Survey has promised its co operation if local authorities make immediate revisions by air survey The scheme would admit of the 16,000,000 acres of town planning areas in England and Wales being covered within two years The country would be divided into sixteen units, of which eight would be photographed concurrently On the reasonable assumption that 30 days in the year would be suitable for vertical photography the work could be done in the two years available Local authorities would be supplied with prints on a scale of 1 : 5000 and a set of transparencies on the same scale as the Ordnance sheets The originators of the method are Messrs H Hemming, Ltd , and Economic Air Surveys, Ltd The fully revised Ordnance sheets would follow later

Aerial Surveys in the United States

AN extended scheme of aerial mapping in the southern States is planned under the United States Geological Survey in co-operation with the Shore and Geodetic Survey, the Census Bureau and other Federal bodies The area to be covered, according to a report issued by Science Service, of Washington D C is 40,000 square miles, selected from agencies in the States of Alabama, Arizona, Arkansas, California, Georgia, Louisiana, Mississippi, New Mexico, South Carolina, Texas and the District of Columbia The maps will be used primarily in connexion with the agricultural census to be made in November next, but will have a permanent use as State records and for other purposes The need for a more systematic land survey is indicated by the fact that air reconnaissances have already revealed the existence of vacant farms and waste lands not under cultivation hitherto unrecorded and consequently in some instances escaping taxation There may be an extension of the scheme later to cover 1,000,000 square miles As at present planned, it will take seventy days to complete at a cost of 650,000 dollars The aeroplanes will have the co operation of link men on the ground under observation, and altogether 500 engineers with 1,500 assistants will be employed The scheme is part of the programme of the Civil Works Administration for the relief of unemployment

Records of the Maya

STUDENTS of American archæology will welcome the publication by the Carnegie Institution of Washington of "The Book of Chilam Balam of Chumayel"—the Book of Balam the Prophet, which, giving an account of certain matters pertaining to ritual and belief as recorded by the ancient Maya in their own language, is one of the most important pieces of documentary evidence relating to the early history of Yucatan known to scholars The book has been edited by Mr Ralph L Roys, who for the first time has applied the principles of classical scholarship to the establishment of a standard text The text is accompanied by a translation and annotations by the editor There are several versions of the Book of the Prophet Balam, each known by the name of the village to which it belonged originally, such as that of Tizimin, Ixil, or Nah That of Chumayel, with those of Tizimin and Mani, have the greatest value for the study of Maya civilisation Chilam Balam, whose prophecies are recorded among the matter in his book, lived at the end of the fifteenth century and the beginning of the sixteenth The Chumayel version dates only from 1782, but there is little doubt that the greater part of it has a pedigree as an authentic copy going back to the sixteenth century when the Maya wrote down in the European script, but in their own language, prophecies, chronicles, rituals, myths, calendrical matter and medical treatises, much of which would appear to have been transcribed directly from the hieroglyphic manuscripts afterwards destroyed and proscribed by the Spaniards The original manuscript of the Chumayel version has disappeared, and the present text has been prepared from photographic copies

Nature Sanctuaries in Zululand

NATAL possesses five sanctuaries for wild life, and all, with the exception of the bird sanctuary at St Lucia and False Bay, have special interest on account of the rare mammals they contain—the Umfolosi has the only surviving herd of the southern white rhinoceros The reserves have been threatened to some degree because of the fear that their mammals preserved a reservoir of the trypanosomes of the cattle disease, nagana But it may be accepted that the destruction of big game is a futile method of controlling the tsetse borne disease, and that the reserves may well be retained, since they occupy areas unfitted for agriculture on account of endemic nagana, malaria, insufficient rainfall or poverty of soil Indeed, in a pamphlet on Natal's Nature Sanctuaries in Zululand" E K du Plessis urges that they should be properly established and made statutory, that they should be provided with suitable approaches to encourage tourist traffic, and that they should be surrounded by a three-mile buffer zone, to prevent shooting parties from slaying animals on the very border of the reserve It is further suggested that the shooting season should close at the end of September, since the does are in young by October, and that all year licences for shooting should be discontinued

Lancashire and Cheshire Fauna Records

THE issue of the nineteenth annual report of the Lancashire and Cheshire Fauna Committee for the year 1932 adds *Plastosciara Egertoni*, from Rostherne Mere, Cheshire, as a new species to science, while a list of a hundred new species added to the faunistic records for the two counties includes 38 Mallophaga on the birds and mammals, which Mr H Britten is investigating, 20 Diptera, 17 sawflies, 10 Coleoptera, 9 Hymenoptera, 3 Anoplura, and one each of Lepidoptera, Arachnida and mites The avi fauna records for the year include the nesting of the golden eye and of the pochard in Cheshire for the first time, and the occurrence of a flock of knots (*Calidris canutus*), estimated to number 7,000, on the Lancashire coast in July White fronted geese and grey lag geese are increasing in north Lancashire in winter, while tufted ducks, teal, shoveller and little owl are also reported to be increasing in parts The main colony of Sandwich terns on Walney Island Lancashire was wiped out by the herring and lesser black backed gulls the colony of which, established five years ago, has assumed alarming proportions The terns from Walney went to nest at Ravenglass ternery where the Sandwich terns have increased from 12 pairs in 1930 to 70 in 1931, and 370 in 1932 The ruff (*Philomachus pugnax*) is still a regular autumn migrant and records are made of the wood sandpiper (*Tringa glareola*), green sandpiper (*T ochropus*), greenshank (*T nebularia*) and grey phalarope (*Phalaropus fulicarius*) on passage, while large numbers of black tailed godwits were seen in the spring on the coast The Fauna Committee announces that it will dedicate Part 2 of its Check List of the Fauna of Lancashire and Cheshire' to the late T A Coward, for many years one of the recorders of the Committee, Part 1 having been issued in 1930 Mr A W Boyd is president of the Committee and H E Britten, Prof S J Hickson and W Mansbridge vice presidents

National Museum of Wales

THE annual report for 1932–33 of the National Museum of Wales shows with what fine spirit the people of Wales are supporting their progressive Museum The opening of the exhibition galleries in the east wing threatened to be marred by the existence of a considerable debt upon the building, but a public appeal has resulted in the receipt of more than three hundred contributions, so that, as promised moneys come in, the debt will be finally extinguished The Folk Industries Gallery in the new wing was opened to the public in July 1933 It illustrates a side of museum activity of much interest to the public Amongst the exhibits are the plant of a woollen yarn factory, and series showing the whole range of the woollen industry in Wales, cider making, sawing, fishing and pottery making An early cast iron gate, an engine from Neath Abbey Iron Works and an early colliery tram illustrate the transition effected by the Industrial Revolution Special reference should be made to the reconstructions of a rural smithy and a wood turner's shop

Cabbages and Related Crops

THE second edition of Bulletin No. 53 of the Ministry of Agriculture ("Cabbages and Related Green Crops", H M Stationery Office, pp 60 1*s* 3*d* net) was issued in November 1933 It deals with the commercially useful variants of the wild *Brassica oleracea*, namely, cabbages and savoys, Brussels sprouts, cauliflowers, broccoli and kale Details of cultivation in many districts are combined with extensive notes on the economic uses of various products, and numerous methods of marketing are given Production and harvesting of seed are also discussed The volume is designed to help the grower, and should do this effectively A chapter on the cultivation of *Brassica* as farm crops has been added to the material published in the first edition, and the whole text has been improved by the incorporation of much recent knowledge

Liverpool Observatory

THE report of the Liverpool Observatory and Tidal Institute for 1933 records several interesting matters concerning tidal records Experiments were made with seismographs with the view of recording the tilting of the earth due to tidal loads as well as to thermal effects An instability in the records was traced to distortion in the structure supporting the instruments This was overcome and satisfactory records were obtained The work is being continued with improvements in the instruments Another important piece of work concerns a new method of prediction of mixed diurnal and semi diurnal tides Work was also done on the tidal bore of the Trent and on the tides of the Bay of Biscay Tidal predictions have been worked out for various authorities

Rainfall of the World

MOST maps hitherto constructed to show the mean annual distribution of rainfall are confined to the land areas and have no indication of rainfall over the oceans Prof W Meinardus has published in *Petermanns Mitteilungen* (1934) a new rainfall map on a scale of 1 100 000,000 which shows the distribution over the entire surface of the globe On so small a scale it naturally does not differ materially so far as land areas are concerned from Supan's and other maps, although it shows effectively the low precipitation in north and south polar regions, but over the oceans, and in particular the Indian and Pacific Oceans, there is much of interest These details have been taken chiefly from G Schott's oceanic maps The map is produced in tints of two colours showing six different grades of rainfall.

Study of Cosmic Rays in Armenia

PROF A F JOFFE, of the Physico Technical Institute of the U S S R, is sending out a scientific expedition to Erivan to establish a laboratory for the study of the cosmic rays It is proposed to set up the station on Mount Alagöz, in Armenia, at a height of 14,400 ft above sea level The object of this station will be to investigate the distribution of the cosmic rays The leader of the expedition is Dr D V Skobeltzin It has also been decided to set up on the shore of Lake Gokcha (6,345 ft above sea level) an astrophysical observatory where a 16 in reflector will be erected

Announcements

Sir Sidney Harmer, formerly director of the Natural History Departments, British Museum, has been awarded the Gold Medal of the Linnean Society The medal will be presented at the annual general meeting on May 24

Prof Victor Van Straelen, director of the Royal Belgian Natural History Museum and formerly vice president of the Parc National Albert in the Belgian Congo, has been appointed president of the Parc National Albert in succession to King Leopold III, who held the office of president until the death of his father, King Albert

We are glad to learn that the Belgian Parliament has now made ample provision for the preservation of the unique collection of skeletons of the Wealden Dinosaur Iguanodon in the Royal Museum of Natural History Brussels, to which we referred on March 3 (p 320) The late King Albert, who was always deeply interested in scientific research, had the satisfaction of learning, just before his death, that a sum had been voted both for the repair of the fossils and for their enclosure in two large glass cases The work is proceeding at once

An earthquake of moderate intensity was recorded at Kew Observatory on May 4 The first impulse was received at 4 h 46 m 22 s G M T The records indicate that the shock occurred at a distance of 4,500 miles and probably near the coast of British Columbia

At the anniversary meeting of the Royal Society of South Africa held at Cape Town on March 21, the following were elected officers for the year 1934 *President*, Dr A W Rogers, *Hon Treasurer* Prof L Crawford, *Hon General Secretary*, A J H Goodwin, *Hon Editor of Transactions* Prof R S Adamson, *Hon Librarian* Prof E Newbery

The following appointments in the Colonial Agricultural Service have recently been made by the Secretary of State for the Colonies Mr C H Burgess to be agricultural field officer, Federated Malay States, Mr J R E Hindson to be inspector of plants and produce, Gold Coast, Mr R K Kerkham to be agricultural officer, Uganda, Mr R W Kettlewell to be district agricultural officer, Nyasaland, Mr A E Moss to be inspector of plants and produce, Gold Coast, Mr E Williams to be superintendent of agriculture, Gambia, Mr F M Bain, formerly inspector, plant protection ordinance, Trinidad, to be agricultural officer, Trinidad, Mr T McEwan, formerly senior agricultural research officer, Northern Rhodesia, to be agricultural officer, Uganda

The Dorothy Temple Cross Research Fellowships in Tuberculosis of the value of at least £350 each for one year for the academic year 1934–35 will shortly be awarded by the Medical Research Council, and applications should be lodged with the Council not later than June 1 The object of these fellowships is to give special opportunities for study and research to persons intending to devote themselves to the advancement by teaching or research of curative or preventive treatment of tuberculosis in all or any of its forms The fellowships will preferably be awarded to candidates who wish to make their studies or inquiries outside the borders of Great Britain It may also be possible to award a Senior Fellowship of considerably greater value to a specially well qualified candidate wishing to undertake an intensive study of some particular problem of tuberculosis at a chosen centre of work in another country Particulars are obtainable from the Secretary Medical Research Council, 38 Old Queen Street, Westminster, S W 1

Applications are invited for the following appointments, on or before the dates mentioned —A lecturer in geography (woman) at Bingley Training College—The Education Officer, County Hall, Wakefield, Yorks (May 16) A teacher of domestic subjects at the National Society's Training College of Domestic Subjects, Berridge House, Fortune Green Road, London, N W 6—The Principal (May 21) A clinical biochemist at the Glasgow Royal Infirmary—The Superintendent, Royal Infirmary, Castle Street, Glasgow (May 21) A lecturer in experimental psychology at the University of St Andrews— The Secretary (May 24) An assistant lecturer in physics at University College Gower Street, London W C 1 —The Secretary (May 26) A fuel technologist to the Public Service Board of New South Wales— The Official Representative of the Government of New South Wales, Wellington House, 125, Strand W C 2 (May 31) A reader in dyeing and printing, a reader in chemical engineering a lecturer in experimental dyeing, a lecturer in industrial and tinctorial chemistry, and a lecturer in fuel technology at the University of Bombay—The Registrar (May 31) A lecturer in economics, an assistant lecturer in pharmaceutical chemistry, a demonstrator in mechanical engineering, and a demonstrator in electrical engineering at University College, Nottingham—The Registrar (June 1) An intelligence officer in the Engineering and Metals Section of the Department of Overseas Trade—The Chief Establishment Officer, Department of Overseas Trade, 35, Old Queen Street, Westminster, S W 1 (May 31) Two Robert Blair fellows in applied science or technology—The Education Officer (T 3), The County Hall, S E 1 (June 1) A junior scientific officer (chemist) in the Department of Scientific and Industrial Research—The Secretary, 16, Old Queen Street, London, S W 1 (June 2) An assistant lecturer in mechanical engineering at the Manchester Municipal College of Technology—The Registrar (June 4) A lecturer in geography at Truro Training College— The Principal Assistant keepers in zoology, entomology and botany at the British Museum (Natural History)—The Secretary, British Museum (Natural History), London, S W 7 A professor of botany at the University of Reading—The Registrar

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Mass of the Neutron

THE mass of the neutron has been calculated by Chadwick on the assumption that the neutrons of boron are emitted by the isotope $^{11}_{5}\mathrm{B}$, according to the nuclear reaction

$$^{11}_{5}\mathrm{B} + ^{4}_{2}\mathrm{He} = ^{14}_{7}\mathrm{N} + ^{1}_{0}n$$

Using the exact masses of $^{11}_{5}\mathrm{B}$, $^{4}_{2}\mathrm{He}$ and $^{14}_{7}\mathrm{N}$ and the maximum energy of the neutron excited by the α rays of polonium, one may calculate for the neutron a mass 1 0068 (taking $^{16}\mathrm{O} = 16$) [1]

We have suggested[2] that the emission of the neutron of boron is due to the isotope $^{10}_{5}\mathrm{B}$ and not to $^{11}_{5}\mathrm{B}$ The nucleus $^{10}_{5}\mathrm{B}$ can suffer two kinds of transmutation under the action of the α particles of polonium one with the emission of a proton, one with the emission of a neutron and a positive electron, according to the equations

$$^{10}_{5}\mathrm{B} + ^{4}_{2}\mathrm{He} = ^{13}_{6}\mathrm{C} + ^{1}_{1}\mathrm{H}$$

$$^{10}_{5}\mathrm{B} + ^{4}_{2}\mathrm{He} = ^{12}_{6}\mathrm{C} + ^{1}_{0}n + \overset{+}{\varepsilon}$$

Our latest experiments on the creation of new radio elements have confirmed our interpretation of the transmutation of boron Similar reactions are observed with the nucleus $^{27}_{13}\mathrm{Al}$ and with $^{24}_{12}\mathrm{Mg}$ The reactions can be divided in two steps

$$^{10}_{5}\mathrm{B} + ^{4}_{2}\mathrm{He} \quad ^{13}_{7}\mathrm{N} + ^{1}_{0}n \qquad ^{13}_{7}\mathrm{N} = ^{13}_{6}\mathrm{C} + \overset{+}{\varepsilon}$$

$$^{27}_{12}\mathrm{Mg} + ^{4}_{2}\mathrm{He} - ^{27}_{14}\mathrm{Si} + ^{1}_{0}n \qquad ^{27}_{14}\mathrm{Si} = ^{27}_{13}\mathrm{Al} + \varepsilon$$

$$^{27}_{13}\mathrm{Al} + ^{4}_{2}\mathrm{He} = ^{30}_{15}\mathrm{P} + ^{1}_{0}n \qquad ^{30}_{15}\mathrm{P} - ^{30}_{14}\mathrm{Si} + \varepsilon$$

$^{13}_{7}\mathrm{N}$, $^{27}_{14}\mathrm{Si}$, $^{30}_{15}\mathrm{P}$ being unstable nuclei that disintegrate with the emission of positrons

The complete reactions, with the masses and energy of all the particles are for the two modes of transmutation of boron

$$^{10}_{5}\mathrm{B} + ^{4}_{2}\mathrm{He} + W_{\alpha} = ^{13}_{6}\mathrm{C} + ^{1}_{1}\mathrm{H} + W_{H} + W_{R}$$

$$^{10}_{5}\mathrm{B} + ^{4}_{2}\mathrm{He} + W_{\alpha} = ^{12}_{6}\mathrm{C} + ^{1}_{0}n + \overset{+}{\varepsilon} + W_{n} + W_{\varepsilon} + W'_{R},$$

where W_{α}, W_{H}, W_{n}, W_{ε}, W_{R}, W'_{R} are the energies of the α particle and the corresponding energies of the ejected particles and of the recoil atoms in the reactions Subtracting the first of these equations from the second gives

$$^{1}_{0}n = \text{mass of proton} - \text{mass of positron} + Q,$$

where $Q = W_{H} + W_{R} - W_{n} - W'_{R} - W_{\varepsilon}$

One gets exactly the same equation using the transmutations of aluminium and magnesium

Thus these equations enable us to calculate the mass of neutron without using the exact masses of any nucleus, except the proton

According to our most recent measurements, the positrons emitted by the new radio elements form a continuous spectrum of maximum energy 1 5 × 10⁶ e v for $^{13}_{7}\mathrm{N}$, 3 × 10⁶ e v for $^{30}_{15}\mathrm{P}$ and approximately 1 5 × 10⁶ e v for $^{27}_{14}\mathrm{Si}$ The emission of positrons is probably accompanied by the emission of neutrinos, but if the positrons have their maximum energy the neutrinos will have a very small energy, the most recent hypotheses on the nature of this particle admits of a mass which is zero, or very small So we need not take this particle into account in the calculations The energy of the recoil atom in the disintegration with emission of a positron is negligible

For the irradiation with the α rays of polonium we have the following numerical values for the energies (expressed in 10^6 e v)

	W_H	W_R	W_n	W'_R	W_ε	Q (10^6 e v)	Q in units of mass
B	8 05	0 23	3 3	0 59	1 5	+ 2 89	0 0031
Al	7 56	0 11	2	0 33	3 0	+ 2 34	0 0025
Mg	4 82*	0 21	1	0 48	1 5	+ 2 05	0 0022

One gets for the mass of neutron three values 1 0098, 1 0092, 1 0089 These values agree approximately Yet the first, deduced from boron, is the most precise The energies of the neutrons of aluminium and magnesium and the energy of the positrons of magnesium are not well known

From considerations on the stability of the nucleus $^{9}_{4}\mathrm{Be}$, the mass of the neutron should have a minimum value 1 0107 But an error of 0 001 in the determination of the mass of Be seems quite possible

We may adopt for the mass of the neutron a value 1 010, in which the error probably does not exceed 0 0005

With the mass 1 010 for the neutron, the maximum energy of the neutron ejected from beryllium by α particles from polonium should be about 9 × 10⁶ e v The emission of slow neutrons when lithium is bombarded with α particles from polonium, according to the reaction $^{7}_{3}\mathrm{Li} + ^{4}_{2}\mathrm{He} = ^{10}_{5}\mathrm{B} + ^{1}_{0}n$, cannot be explained unless the mass adopted for $^{10}_{5}\mathrm{B}$ is too great namely, by about 0 003

If atomic nuclei contain only protons and neutrons, then the β emission might be the consequence of the transformation of a neutron into a proton inside the nucleus, with the ejection of the negative electron and a neutrino, as has been suggested by several authors The inverse processes would also be possible transformation of a proton into a neutron with the ejection of a positron and a neutrino

With the mass 1 010 for the neutron, the energy liberated in the transformation neutron → proton + $\overset{-}{\varepsilon}$ is 2 1 × 10⁶ e v , the energy absorbed in the transformation proton → neutron + $\overset{+}{\varepsilon}$ is 3 1 × 10⁶ e v

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* The maximum energy possible for the positrons does not correspond to a group effectively observed but has been deduced by F Perrin from the experiments of Bothe and Klarman, by the consideration of the energy balance relative to the groups of protons

[1] Chadwick *Proc Roy Soc*, 136, 692 1932

[2] I Curie and F Joliot *C R* 197 237 1933

Induced Radioactivity of Sodium and Phosphorus

IN view of the discovery of induced radioactivity' by F Joliot[1], I have investigated several other elements with an apparatus specially designed for the study of activities with a very short lifetime The substance to be investigated was attached to the end of a swinging arm, which made it possible to shift the substance within half a second from the α ray source, consisting of about 1 millicurie of thorium B + C to a Geiger Muller counter with a window of 0 05 mm copper foil

I have found that both sodium and phosphorus become active after α ray bombardment Three different sodium compounds (NaCl, NaF, $Na_2C_2O_4$) have been investigated, they all showed a fairly strong activity, dying off very quickly The half value period has been determined by recording the impulses on a rotating drum the whole decay curve being recorded 21 times The half value period was found to be 7 ± 1 seconds Phosphorus (elementary red phosphorus) showed a very much longer lifetime The half value period was found to be 40 ± 5 minutes

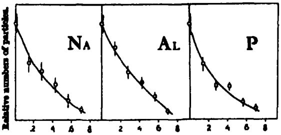

FIG 1

The initial activity of phosphorus was about one sixth that of aluminium The initial activity of pure sodium under the same conditions was estimated from the composition of the salts to be about half that of aluminium

The sign of the particles emitted by the substances was determined by deflection in a magnetic field Both sodium and phosphorus were found to emit mainly positive electrons In the case of sodium no negative particles have been detected, there cannot be more than one fifth of the positives if any In the case of phosphorus the results are not quite so definite, anyhow the negative particles cannot be more than one third of the positives

Some information about the energy of the particles was obtained by putting copper foils between the substance and the window of the counter For a better comparison the same has been done with the particles emitted by aluminium The three absorption curves are given in Fig 1, the mean statistical error being indicated by the vertical lines The range of the particles can be extrapolated to be about 0 8 gm /cm ^{2} of copper, corresponding to an energy of 1 8 × 10^6 e v, for all three elements

The nuclear reactions leading to the creation of these new active elements are very probably analogous to the production of radio phosphorus by bombarding aluminium In that case, the reaction is generally assumed to be ${}_{13}\mathrm{Al}^{27} + \alpha = {}_{15}\mathrm{P}^{30}$ + neutron, the ${}_{15}\mathrm{P}^{30}$ disintegrating after a time according to the reaction ${}_{15}\mathrm{P}^{30} = {}_{14}\mathrm{Si}^{30}$ + positron So for sodium and phosphorus the reactions would be ${}_{11}\mathrm{Na}^{23} + \alpha = {}_{13}\mathrm{Al}^{26}$ + neutron and ${}_{15}\mathrm{P}^{31} + \alpha = {}_{17}\mathrm{Cl}^{34}$ + neutron respectively In the last case, this view was confirmed by the chemical separation of the active chlorine The active phosphorus was burned, the products of combustion dissolved in caustic soda The solution was acidified with nitric acid, a trace of ammonium chloride added and then excess of silver nitrate The silver chloride filtered off and washed on a small disc of filter paper, was found to contain more than 50 per cent of the original activity, showing the same time decay

By extrapolating the series of odd elements ${}_{15}\mathrm{P}^{31}$, ${}_{13}\mathrm{Al}^{27}$, ${}_{11}\mathrm{Na}^{23}$, all of which show induced activity, one would anticipate that ${}_{9}\mathrm{F}^{19}$ would show it too, especially since fluorine is known to emit neutrons under α ray bombardment On the other hand, the extrapolation of the periods 40 min 3 min 7 sec, leads to a very short life for the hypothetical activity produced in fluorine I have tested calcium fluoride in my apparatus, but have not been able to find definite evidence of an activity

O R FRISCH

Birkbeck College,
London
May 4

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[1] NATURE 133, 201 Feb 10 1934

β-Emission of Positive Electrons

THE artificial production of radioactive isotopes recently discovered[1] has to be brought into connexion with the theoretical treatment of the β type of radioactive transformation[2] It is easily seen that the formulæ given for the β decay of heavy elements apply to the emission of positive electrons by simply changing the sign of the charges involved We have calculated the continuous energy spectra to be expected from N^{13} both according to the theory developed some time ago by ourselves and according to the assumption that a so called neutrino is emitted simultaneously with the electron The curves obtained in this way are very similar and may be represented by Fig 1, which has been drawn for a special case It seems to us that it will be scarcely possible to distinguish between those two theories by measuring the shape of the energy spectrum

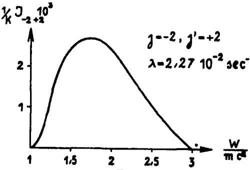

FIG 1

The decay constant however, resulting from the extrapolation of the values known for the heavy radioactive β bodies fits very nicely the order of magnitude of the value of several minutes actually observed (A more exact comparison cannot be made unless the upper energy limit of the continuous energy spectrum has been determined) This fact seems to confirm the view previously taken by us, that the extremely long life period of the lighter β bodies (potassium and rubidium) should not be compared with that of the other β active substances The extremely high values of the decay constants of these elements have evidently to be explained by a more complicated mechanism, possibly by a double process in which two electrons leave the nucleus simultaneously

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March 15

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[1] I Curie and F Joliot, *C R Acad Sci* 198 254, 1934 J D Cockroft, C W Gilbert and E T S Walton NATURE, 133, 335, March 3, 1934

[2] G Beck and K Sitte, *Z Phys* 86, 105 1933 E Fermi, *La Ricerca Scientifica*, 2, No 12.

Slip-bands and Twin-like Structures in Crystals

THE β-constituent of the copper zinc alloy system containing about 48 50 per cent zinc and having a cubic body-centred crystal lattice does not readily show slip bands when the crystals are distorted[1] On the other hand structures resembling twins have been described[2] v Göler and Sachs[3] found slip bands on some crystals only and identified them approximately with traces of dodecahedral planes {110} I have recently confirmed the occurrence of slip bands agreeing with the traces of {110} planes in a number of crystals (Fig 1) and in some cases the distortion can be accounted for completely by slip on one of these planes and in a direction parallel to the normal of an octahedral plane [111] More often the distortion is more complicated and other dodecahedral planes are involved In these circumstances the slip bands do not represent crystal planes but relics on the surface of the original traces of planes

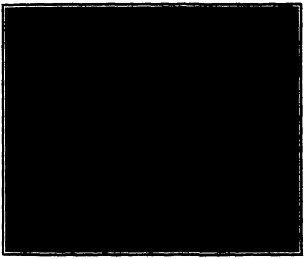

FIG 1 Two deformed β brass crystals showing slip-bands and twin like structure near boundary × 100

Twin like structures are produced when slip takes place on two planes equally inclined to the axis (in a tensile test) in different parts of the same crystal This frequently occurs if the axis lies in a {100} plane for example when the uniting plane coincides with this plane at the beginning of the distortion but soon ceases to do so as deformation proceeds These structures persist when the crystal is repolished and re-etched and resemble lamellar twinning if there are many of them

When the crystals are rolled they fracture with an almost perfect cleavage parallel with one or more {110} plane The separation occurs with a loud crack

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March 23

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[1] G I Taylor *Proc Roy Soc* A 118 1928

[2] F Johnson *J Inst Metals* 24 301 1920

[3] v Göler G Sachs, *Naturwiss* 412 1928

Intensity Measurements in the First Positive Bands of Nitrogen

WE have recently measured the intensities of several of the first positive bands of nitrogen using the method of photographic photometry As sources the afterglow of active nitrogen and a high frequency electrodeless discharge in nitrogen at a low pressure have been used The figures in the second and third columns below are proportional to the energy radiated per second by the gas due to the various vibrational transitions indicated

Band v – v	Intensity		Intensity ratio H F discharge/Afterglow
	H F discharge	Afterglow	
10-6	294	128	2 30
10-7	245	99	2 48
11-6	68	102	0 67
11 7	300	520	0 58
11 8	159	270	0 59
12 7	74 5	59	1 26
12 8	244	190	1 28
12 9	151	55 5	2 72

If the probability of a transition occurring between two levels is independent of conditions of excitation it is evident that the figures in the last column must be constant for bands having a common value of v Our results show that this is the case for $v = 10$ and 11 to within 15 per cent but does not hold for bands having $v = 12$ There is however close superposition of the 4 0 band on the 12 9 band which would have the effect of increasing the apparent intensity of the 12 9 band In the afterglow of active nitrogen the progression having v 4 is very weak but in the high frequency discharge (and in direct current discharge) it is of appreciable strength These facts would be sufficient to account for the variation noted in the table

Preliminary measurements with direct current excitation give results in which the intensity ratio H F discharge/D C discharge is nearly constant within each progression examined

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May 5

Influence of Oxygen, Sulphur Dioxide and Moisture on the Homogeneous Combination of Hydrogen with Sulphur

PREVIOUSLY[1] we have shown that minute traces of oxygen lead to an apparent increase in the rate of formation of hydrogen sulphide from its elements as judged by the iodine titre of the resulting gaseous products The increase was ascribed to a catalysis by oxygen though we pointed out that the effect of so minute a quantity of oxygen is remarkable and unexpected The subject has been systematically investigated using hydrogen containing known concentrations of oxygen ranging from 0 06 to 7 per cent by volume at temperatures between 290° and 343° C The method adopted a static one[2] was carried out in Pyrex bulbs containing quantities of sulphur which, whilst always sufficient to combine with the oxygen present several times over, were yet insufficient to leave any liquid at the temperature of the reaction The products consisted of a mixture of sulphur dioxide and hydrogen sulphide together with the excess of sulphur and hydrogen The amount of each compound was ascertained by an iodometric titration followed by a gravimetric estimation

The results showed that the whole of the oxygen goes to sulphur dioxide in the first few minutes, and that, thereafter the hydrogen proceeds to react with the remaining sulphur at precisely the anticipated velocity for hydrogen alone In unpacked bulbs, there is no detectable reaction between the sulphur dioxide and the hydrogen sulphide so formed in one hour This shows that neither free oxygen nor sulphur dioxide affect the velocity of the hydrogen sulphur reaction and is contrary to the observations of Norrish and Rideal[3] who, using a dynamic method, found that oxygen had a strong poisoning effect in the gaseous reaction between hydrogen and sulphur at all temperatures

In packed bulbs some of the sulphur dioxide and the hydrogen sulphide reacts thus $2H_2S + SO_2 \quad 2H_2O + 3S$ (specific mechanism not implied) but only at the glass surface and hence to an undetectably small extent in unpacked bulbs The findings of Taylor and Wesley[4], who showed this reaction to be heterogeneous by a dynamic method are thus confirmed under static conditions

Since steam is formed in packed bulbs, evidently moisture as well as sulphur dioxide, is without effect on the hydrogen sulphur reaction In confirmation of this, hydrogen containing 2 per cent of moisture by volume has been found to give identical velocities with those already established for hydrogen which had been slowly passed over a length of phosphoric oxide

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March 28

[1] NATURE 132 101 July 15, 1933
[2] NATURE 131 471, April 1, 1933
[3] *J Chem Soc* 123, 1689 1923
[4] *J Phys Chem* 31 216 1927

The Theory of Two Factors versus the Sampling Theory of Mental Ability

THE accompanying diagram (Fig 1) gives a graphic representation of the extent to which an observed frequency distribution of 22,712 tetrad-differences (of the form $r_{13}r_{24} - r_{23}r_{14}$) derived from 170 correlation coefficients between 19 non-overlapping mental tests[1] approximates, on one hand, to the theoretical distribution to be expected according to the Two Factor Theory of Prof C Spearman and, on the other hand, to the theoretical distribution to be expected according to the Sampling Theory of Prof Godfrey H Thomson

According to the Two Factor Theory[2], the abilities measured by the mental tests are divisible into two factors each, one being common to all (the general factor, *g*), while the other is in each case specific and independent (the specific factor, *s*)

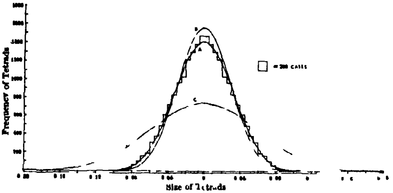

FIG 1 A Best fitting curve (Type IIa Pearson curve) to observed distribution of tetrads with equation

$$y = 1412\left(1 - \frac{x^2}{0\ 17234^2}\right)^{11\ 000} \quad \sigma_t = 0\ 041289$$

B Theoretical curve (Type IIa) to be expected assuming the truth of the Two Factor Theory (Spearman) with equation

$$y = 1563\left(1 - \frac{x^2}{0\ 1557^2}\right)^{9\ 000} \quad \sigma_t = 0\ 02827 \pm 0\ 0025866$$

C Theoretical curve (Type IIa) to be expected assuming the truth of the Sampling Theory (Godfrey Thomson) with equation

$$y = 749\left(1 - \frac{x^2}{0\ 3248^2}\right)^{11\ 000} \quad \sigma_t = 0\ 059 \text{ (allowing also for random sampling)}$$

According to the Sampling Theory[3], any one mental ability is due to the operation of a certain set of factors, another ability to another set, and so on, and these sets may overlap in any manner On this theory, if we assume a number of variable elementary factors, *N*, we can get values for *N* from the observed values of r (0 413) and σ_r (0 087) of our table of 170 correlation coefficients, on certain assumptions as to form of distribution of the factors and of their proportions entering into each ability

Mr John Mackie[4] has given the most generalised mathematical expression, up to date, for the Sampling Theory, and accepting certain of his formulæ as those most likely to apply to our investigation, we have

$$\sigma_r = \sqrt{1 - \left(\frac{2}{\pi}\right)^2} \Big/ \sqrt{N} \qquad \text{(p 32)}$$

that is, $0\ 087 = 0\ 77/\sqrt{N}$, giving $N = 77$

$$\text{and } \sigma_t = 0\ 463/\sqrt{N} \qquad \text{(p 31)}$$
$$= 0\ 052$$

The same value of σ_t follows from $r = 0\ 413$, by the formulæ

$$r = \frac{2}{\pi}\sqrt{p_1 p_2} = \frac{2}{\pi} p \qquad \text{(p 33)}$$
$$\text{and } \sigma_t = 2p(1 - p)/\sqrt{N} \qquad \text{(p 34)}$$

But this value of σ_t does not allow for random sampling (of the population) Allowing for this kind of sampling, the correct value is

$$\sigma_t = \sqrt{0\ 052^2 + 0\ 028^2} \quad \text{(0 028 is the } \bar{\sigma}_t \text{ of the Two Factor Theory)}$$
$$= 0\ 059$$

As a Type II*a* Pearson curve was found to be the best fitting curve for the observed distribution of tetrads with $\sigma_t = 0\ 031$ (curve *A*) similar Pearson curves have been drawn corresponding to the Two Factor Theory with $\sigma_t = 0\ 028 \pm 0\ 0026$ (curve *B*) and to the Sampling Theory with $\sigma_t = 0\ 059$ (curve *C*) It can be seen by inspection which of the two curves *B* or *C* approximates more to curve *A*

Further evidence against the applicability of the Sampling Theory to our data is given if we *assume* the truth of this theory (with Mackie s equations) and set out from the *observed* value of σ_t that is 0 031

$$\text{Since } \sigma_t = 0\ 463/\sqrt{N}$$
$$\sqrt{N} - 15 \text{ and } N = 225$$
$$\sigma_r = \sqrt{1 - \left(\frac{2}{\pi}\right)^2} \Big/ \sqrt{N}$$
$$0\ 051$$

whereas the observed value of σ_r is 0 087

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March 21

Brown W and Stephenson W, A Test of the Theory of Two Factors *Brit J Psychol* 23 Part 4 April 1933 Also NATURE 130 588 Oct 15 1932.

[2] Spearman C The Abilities of Man London 1927 pp 74 75

[3] Thomson Godfrey H *Proc Roy Soc*, A, 95 400, 1919 Also Brown W and Thomson G H Essentials of Mental Measurement 3rd edn 1925, Cambridge University Press chap x

[4] Mackie John Mathematical Consequences of Certain Theories of Mental Ability *Proc Roy Soc Ed* 49 Pt 1 No 2 Feb 1929

Water Supplies and Emergency Legislation

WHEN we wish to determine the relation between the rain falling on an area and the volume of water delivered by the stream draining that area we are faced with a problem as yet unsolved The geological physical and meteorological conditions of river catchment basins are so varied that a search for a mathematical expression connecting yield from rainfall appears to be in vain

The simplest and most accurate method for such determination is as suggested in the leading article in NATURE of April 28 by the actual measurement of stream flow for a considerable number of years so as to ascertain the mean the maximum and the minimum flow that may be expected and also the variation of stream flow during the seasons of the year Comparing the results so obtained with the rainfall during those years we may be able to deduce with some reasonable accuracy stream flow in years in which rainfall records are available and stream flow gaugings are not

Observation of stream flow in Great Britain have been neglected and the same remark applies to observation of water levels in our wells Some years ago the British Association laid down a series of questions in regard to wells which appear to have been lost sight of It is possible that the limited funds allotted for investigations of this nature curtailed the information collected

The heavy rains of 1927 the disaster of January 1928 and the following wet years caused the country to be more concerned with floods and arterial drainage than with drought leading to the appointment of the Royal Commission of 1927 and the passing of the Drainage Act of 1930 and so to the formation of Catchment Boards with the result that schemes for widening and deepening our rivers and carrying off the rainfall as quickly as possible are under consideration

Speculative building on riparian lands subject in former years to flooding at very long intervals are now more frequently flooded due to the increased flow from drainage of lands permeable areas and arterial roads and this has increased the demand for a more rapid carrying away of flow due to rainfall

The problem that now faces the country is the preservation of our springs Most of our rivers derive their dry weather flow from springs the only source of supply of which is the percolation of our winter rains to the ground water plane of saturation and instead of widening and deepening our rivers to pass off extraordinary floods quickly the flood water should be allowed to spill over the river margins so that as the flood slowly subsides the water is enabled to percolate into the subsoil One other suggestion I would make is a return to Mr Joseph Elkington s sink hole drainage That is instead of passing off rain water from whatever sources it may be received into streams and thus swell our rivers it is passed into soakage pits or absorbing wells placed at suitable intervals and sunk to permeable areas and thus to pass the rainfall to ground storage

The Catchment Boards I would suggest should now confine their activities to the measurement of stream flow and its correlation with rainfall to carry out the requirements of the British Association in regard to riparian lands subject to periodic flooding so as to reserve them for pasture or agriculture and to prevent speculative building thereon

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Factors Controlling Moulting and Metamorphosis in an Insect

IN the blood sucking bug *Rhodnius prolixus* moulting occurs at a definite interval after feeding only one meal being necessary in each stage The morphological changes at moulting are relatively slight save at the fifth moult when the insect becomes adult[1] It is therefore convenient (without prejudice to questions of homology) to refer to this final moult as metamorphosis In this last stage the interval between feeding and moulting averages twenty eight days If its head is removed soon after feeding the insect will not moult—although some of these headless individuals have remained alive more than eleven months But there is a critical period about seven days after feeding after which moulting is no longer prevented by decapitation If the blood from an insect decapitated *after* this critical period is allowed to circulate in an insect decapitated *before* this period *the latter is caused to moult* Clearly a moulting hormone is present and it is probably secreted in the head Of the organs in the head the only one which shows distinct changes during this period is the corpus allatum the cells of which swell up to a maximum at about the seventh day after feeding and then diminish Perhaps this is the source of the moulting hormone—though the evidence on this point is still incomplete

Similar results have been obtained with the earlier nymphs But if the blood from a 5th or final nymph decapitated *after* the critical period is allowed to circulate in a 4th nymph decapitated *before* this period, the latter shows a premature 'metamorphosis' and develops adult characters Two explanations of this result are possible either (*a*) the moulting hormone of the 5th nymph differs from the moulting hormone of the earlier nymphs , or (*b*) the hormone is always the same, but the earlier nymphs produce in addition an inhibitory hormone which restrains metamorphosis Of these alternatives the second appears to be correct For if the 4th, 3rd, 2nd, even the 1st nymphs are merely decapitated around the critical period', a certain number of them suffer a precocious metamorphosis' and develop into diminutive adults , while others show intermediate characters (prothetely) —due, perhaps, to the varying quantity of the inhibitory factor present in the blood at the time of decapitation

Two factors, therefore, seem to be concerned in the growth of *Rhodnius* a factor initiating growth or moulting, and a factor inhibiting 'metamorphosis' —both probably secreted in the head, and perhaps in the corpus allatum These results, which will shortly be published in full, confirm and extend the well known conclusions of Kopeć[2]

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April 12

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[1] Wigglesworth V B *Quart J Micr Sci* 76 270 1933

[2] Kopeć S , *Biol Bull* 42 322 1922 46 1 1924 *Biol Generalis* 3 375 1927

Spontaneous Crossing-over between *X*- and *Y*-Chromosomes in *Drosophila melanogaster*

MULLER and Painter[1] showed that more than one third of the *X* chromosome is almost inert genetically and corresponds to a section of the *Y*, and Friesen[2] obtained crossing over of autosomal genes in males by exposure to X rays It therefore seemed worth while investigating whether crossing over takes place between the *X* and *Y* chromosomes in the male during normal meiosis The gene under investigation, *bobbed* (shorter and finer bristles on the thorax), is the only one so far located both in the inert region and the *Y* chromosome

Males containing the mutant gene *bb* (bobbed) in their *Y* chromosome and its normal allelomorph in their *X* chromosome were crossed with bar bobbed females with attached *X* chromosomes carrying *Bbb* (bar eye) and a *Y* carrying *bb* By this method every change taking place in either *bb* locus in the male can be detected

The result of the cross was

	Expected flies		Exceptional flies	
Phenotype	*Bbb*♀	normal♂	*B*+*bb*♀	*bb*♂
	422	566	4	5

The exceptional *B*+*bb* females (bar, non bobbed) and *bb* males (non bar, bobbed) could have arisen either by crossing-over or by mutation both of normal to *bb* in the *X* chromosome, and of *bb* to normal in the *Y* chromosome The *B*+*bb* females could not have arisen by detachment of one of the attached *X* chromosomes since they were homozygous for bar eye The hypothesis of mutation seems to be excluded by the high frequency of the exceptions

The possibility of spontaneous crossing-over in the males has been suggested by Stern's[3] discovery of translocation of parts of the *Y* to the *X*-, and Darlington's[4] description of cytological conditions in the spermatogenesis of *Drosophila pseudo-obscura*, which makes the occurrence of crossing-over quite possible

U PHILIP

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April 28

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[1] *Z ind Abst*, 62 1932

[2] *Science* 78, 1933

[3] *Z ind Abst* 51, 1929

[4] *Genetics* 19 1934

The Attitude of the German Government towards Science

PROF STARK'S letter in NATURE of April 21 may not prove convincing to all its readers The fact that non Aryans' have been expelled from other posts does not necessarily justify their expulsion from scientific positions unless the premise that 'two blacks make a white' has first been conceded

It is difficult also to reconcile his assertion that scientific research is perfectly free in Germany with the reported speeches of such officials as the rector of University of Frankfort, who is alleged[1] to have said Nowadays the task of the universities is not to cultivate objective science, but soldier like, militant science, and their foremost task is to form the will and character of their students" This is not an isolated example of the attack on objectivity, on, in plain English, truth, which appears to be taking place in modern Germany For that reason many British scientists feel that criticism of the present German government may not merely be of value to their expelled colleagues, but also to those 'Aryan Germans who are still trying, under very difficult conditions, to uphold their country's great tradition of objective science

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[1] *Science*, June 2, 1933

Psychology of Musical Experience

I HAVE long been impressed by a passage about Lagrange, the prince of mathematicians, in Thomas Young's biographical sketch "In the midst of the most brilliant societies he was generally absorbed in his own reflections and especially when there was music, in which he delighted, not so much for any exquisite pleasure that he received from it, as because, after the first three or four bars, it regularly lulled him into a train of abstract thought, and he heard no more of the performance, except as a sort of accompaniment assisting the march of his most difficult investigations, which he thus pursued with comfort and convenience "

I now notice that it correlates rather closely with a remark of Darwin, the prince of naturalists, in the well known passage in his autobiography where, after describing the atrophy of his tastes for literature and painting and music, he proceeds "Music generally sets me thinking too energetically on what I have been at work on, instead of giving me pleasure "

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Research Items

Prehistoric East Anglia Dr Cyril Fox, in his presidential address to the Prehistoric Society of East Anglia for 1933, which is published in full in the *Proceedings* of the Society, vol 7, pt 2, discusses the implications of a series of maps showing cultural distributions from neolithic times to the iron age, that is, from about 2300 B C to A D 50 He points out initially that in the Lowland area of Great Britain, of which East Anglia is a part, human distribution is determined by the character of the soil Hence East Anglia is divided into three zones, of which two a western and an eastern, suitable for the habitation of early man, are separated by an unsuitable area, a plateau, forming the East Anglian watershed, which is extended southward to the Thames valley by the exposure of the London clay In each successive period, therefore, the distribution maps show that the area of closest settlement was within the inner curve of the clay covered watershed, with a second area of density in the lower Thames valley and estuary A shift of the population on the chalk belt in the course of ages was accompanied by a like southward movement on the coastal belt, as the estuarine trade sought the shortest route to its markets in the centres of denser population through the valleys which penetrated the plateau in the direction of the settlement area on its western side Changes in distribution of population on the chalk belt in the later periods indicate the opening up of fertile but less easily worked, lands by the Iron Age Celtic tribes, to whom the Belgæ found themselves opposed and against whom they erected their great system of earthworks, when they had occupied the hitherto unexploited land around St Albans, which they had reached from the Thames valley and not from the east coast Differences in type of distribution bring out clearly the distinction between the products of a locally developed culture, of objects imported by trade, and of those introduced by invasion The series of maps strikingly confirms the reliability of the available data as an index—though an incomplete reflection—of the life of the dwellers in the region, showing where it was vigorous, where it was sluggish, and where almost entirely absent

Mass Physiology in Animals W C Allee (*Biol Rev*, 9 Pt 1, 1934), in reviewing recent work on mass physiology, remarks that analysis of the reactions leading to the formation of aggregations in Nature, or in the laboratory, has scarcely proceeded beyond the recognition that much of such behaviour is innate, although recent evidence indicates that a part of the schooling behaviour of the fish *Ameiurus* is acquired rather than inherited It is easy to demonstrate that overcrowding lessens the rate of growth of organisms, evidence is presented that undercrowding (for example, in mealworms, fishes, mice) frequently has the same effect The results from aggregation upon the rate of oxygen consumption vary with different animals, thus, for example, goldfishes in small groups use less oxygen than when isolated, but with the more closely schooling *Ameiurus* opposite results are reported Groups of animals are able to afford protection to their members if exposed to toxic conditions due to the absence of accustomed salts (as the marine flat worm *Procerodes* does when placed in fresh water) or to the presence of toxic substances such as colloidal silver The amount of protection has been measured for some examples and the protective mechanisms are discussed The transition from parthenogenetic to sexual reproduction in certain Crustacea (Cladocera) has been shown to result from overcrowding The effect of numbers present upon the rate of learning differs with different animals and even in the same animals with different problems, thus, fishes learn to run a simple maze more rapidly if in groups than if isolated, but they learn less readily to jump for a bit of worm held just above the water level Cockroaches learn to run a simple maze more slowly if more than one is present in the maze at the same time Groups of birds show a fairly definite flock organisation which may or may not be related to active leadership of the flock The whole range of mass physiology has been presented with the thought that it forms a large part of the background for social life'

New Snails from Hawaii Mr C Montague Cooke, jun in his paper New Species of Amastridæ ' (*Bernice P Bishop Museum, Occasional Papers*, 10, No 6, 1933) describes many new members of this interesting genus, which is peculiar to the islands of the Hawaii group, usually living on or under trees or under wood and stones These snails are viviparous and bear embryos of a fair size, the embryonic whorls having distinct sculpture One specimen of *Amastra* (*Metamastra*) *gulickiana dichroma*, new sub species, although not quite fully grown contained an embryo of about two and a half whorls Many of the shells, however, were found dead and in one locality, East Maui, Kula, near the division between the lands of Keokea and Kamaole where there are the last remnants of a native forest of a few decades ago, there were numbers of dead shells of several species and genera scattered among the loose surface stones Under a single stone about two or three quarts of the richest fossiliferous earth was uncovered From this mass of earth about 1,300 whole or nearly whole shells were picked out with representatives of about 70 species belonging to 23 genera including a new species *Amastra inopinata* Undoubtedly this region was inhabited by a rich land snail faûna some time within the last hundred years A number of these species must be entirely extinct as no native forest area is located within several miles The shape of the various forms varies enormously, some of the shells flat and almost like a *Planorbis* others *Achatina* shaped, some sinistral

Japanese Decapods A valuable monograph on the distribution of decapod crustaceans inhabiting the continental shelf around Japan, chiefly based upon materials collected by the S S *Sôyô Maru*, during the years 1923–30, by Yu Yokoya (*J Coll Agric, Tokyo Imperial University*, 12, No 1, 1933) gives a very good idea of what is common and what is rare in this area, all the records are given with sex and egg (if any) included, so that the breeding seasons are also shown The extensive material from 658 stations was collected during the biological survey of the continental shelf of Japan, surrounding Honsyû, Sikoku and Kyûsyû, by the surveying ship of the Imperial Fishery Experimental Station of Tokyo 292 species of decapods are recorded, 52 being new to science, and there are 33 new records for Japanese waters, whilst 3 new genera are proposed. Most of the stations were of 100–400 metres depth, therefore few shallow water forms are included. Some species have a northerly distribution extending from central Japan as far as the Bering Sea, Alaska and the west of America, others a southerly distribution to the Malay Archipelago, Indian Ocean and Australia. The northern species were collected mainly from the west side of Japan, the southern species mainly from the east, but there are some notable exceptions and the subject is a complicated one which is discussed together with the position of the currents. Two main currents are well known, the warm current, the 'Kuro siwo", sweeping the south east coast from the East Indian region and turning eastward, and the cold current, the "Oya Siwo", entering the North Pacific by the Bering Strait, principally deflected along the western side.

Hydroids as Enemies of Fishes. E. W. Gudger (*Ann. Mag. Nat. Hist.*, 13, No. 74, Feb. 1934) remarks that the lower invertebrates are commonly thought of as food for fishes rather than as enemies—and so they are broadly speaking—but he brings together the recorded observations on *Hydra* and sessile colonial hydroids as fish eaters, beginning with those of Trembley (1744) who saw young roaches, about one third of an inch long, caught by the tentacles of *Hydra*, carried to the mouth and swallowed. Beardsley (1904) found the mortality among trout fry in the troughs of a hatchery at Leadville, Colorado, to be due to the presence of great numbers of *Hydra pallida* (130 per square inch in one trough) and a heavy mortality in the ponds of a trout hatchery in Germany was due to the presence of *Hydra fusca*. The author summarises the accounts of the attacks of *Polypodium* on the ovarian and free ova of the sturgeon of the Volga, of the colonial hydroid *Hydrichthys mirus* which has been found on sea fish off Rhode Island and was believed by Fewkes (1887) to be parasitic, of *H. boycei* described by Warren as parasitic on *Mugil* and other fish in South Africa, and lastly of a species of *Clytia* which fed on young angler fish (*Lophius*) in jars in the Plymouth Laboratory.

Parasites of the Hessian Fly. Miscellaneous Publication No. 174 of the U.S. Department of Agriculture (Dec. 1933) consists of a paper by Mr. A. B. Gahan on the serphoid and chalcidoid parasites of the Hessian fly in America. Some 41 species are clearly described and figured with very full synonomy and biological data. Since many of the species dealt with also occur in Europe, this work is one which is of importance to British and other extra American students of the parasitic Hymenoptera. Particular interest is attached to the species *Eupelmella* (*Eupelmus*) *vesicularis*, Retz., which appears to be one of the most polyphagic species of all the Chalcids, since its recorded hosts embrace no fewer than 68 species, belonging to six of the major orders of insects. This feature is all the more remarkable from the fact that the insect has greatly abbreviated wings and is incapable of flight. Five generations have been reared in a single season and males are unknown. Geographically it extends from the British Isles to Russia eastwards, and to Italy in the south. In North America it is likewise very widely distributed. Owing to its polyphagic habits, it appears to be of little economic value as a primary parasite. The most efficient parasite in the biological control of the Hessian fly seems to be *Platygaster hiemalis*, Forbes and, in North America, it is practically the only species which attacks the autumn generation of that host.

Plant Tumours and Polyploidy. Dontcho Kostoff and James Kendall give some details (*Archiv Mikrobiologie*, 4, 487; 1933) of the cytology of tumourous growths produced in plants by various means—in some cases occurring generally over an interspecific hybrid, in others induced by injection of various chemical substances into the tissues or by injection with *Bacillus tumefaciens*. They regard these tumours as in all cases similar in construction, and in certain cases have been able to show that some of the cells in their neighbourhood have become either binucleate or multinucleate or polyploid. Such nuclear changes they attribute to an increased viscosity of the protoplasm, which makes the separation of the chromosomes more difficult after they have divided. From the neighbourhood of these tumours in some cases roots arise in which all the cells are polyploid or which have a chimæral structure as regards polyploid and normal nuclear apparatus. In other cases it was possible by cutting back shoots in the neighbourhood of tumours to obtain polyploid shoots and thus polyploid individuals could be separated and propagated. The authors are thus led to suggest that some of the various polyploid types that have been found growing naturally may have arisen as the result of cell disturbances produced by bacterial or other infection.

Earthquake Seawaves in North-East Japan. The Pacific coast of north eastern Japan, perhaps more than any other region in the world, is subject to the inrush of destructive *tunamis* or earthquake seawaves, the most recent examples being those of 1896 and 1933. Earlier *tunamis* along the same coast are described by Prof. A. Imamura (*Japan J. Astr. Geoph.*, 11, 79–93; 1934), who gives two reasons for their occurrence and destructiveness. Off this coast lies the deep Tuscarora trench, in which changes of level occur one after another in its bed, while the coast contains numerous V- or U-shaped bays opening towards the trench. Excluding *tunamis* less than 10 ft. in height, Prof. Imamura enumerates 15 from 869 until 1933, of which those of 869 and 1611 were the greatest. In the latter year, about 4,783 lives were lost, the height of the waves being 66 ft. as compared with 48 ft. in 1896 and 20 ft. in 1933. From 1611 until 1689, there were five *tunamis* along this coast. Then came a pause of one and a half centuries, followed by another epoch of activity culminating in the disaster of 1896. A few hours before the arrival of the *tunamis* in 1894, 1896 and 1933, large secondary undulations were observed in the water of the V-shaped inlets, suggesting that minor crustal deformations had occurred before the great movements that gave rise to the main *tunamis*.

Long Period Temperature Changes. In the *Monthly Weather Review* of September 1933 there is an interesting study of long period temperature trends by J. B. Kincer, that is carried back in certain cases to the latter part of the seventeenth century. A number of temperature records are analysed in a manner that has been found specially suitable for showing gradual changes The sum of the annual mean temperatures for the first twenty years of a record is obtained and is plotted as the first point on a curve additional points being obtained by subtracting the figure for the first year and adding that for the twenty first and so on In this method an occasional exceptional year or two has only a slight effect on the general run of the curve The analysis was applied to records in middle latitudes both in North America and Europe and to a few other parts of the world with rather striking results It appears that in middle latitudes there has been an upward trend since about the second quarter of the nineteenth century in spring autumn and winter the change being generally about 3 —a substantial figure when dealing with means for periods so long as twenty years The longest records are generally made in or very near to large towns and the possibility that the effect may be due to the growth of such towns and the consequent increase of the influence of artificial heating was considered A number of overlapping records at town and country stations in the same State in America showed such striking similarity that it was concluded that the effect is general and corresponds with a world wide change of climate

Absorption of 1 cm Waves Cleeton and Williams have successfully produced waves down to 1 1 cm in length by a vacuum tube oscillator and have made absorption measurements of these waves in ammonia gas (*Phys Rev* Feb 15) In accordance with a theory of Dennison the gas shows a strong absorption band in this region with a maximum absorption at λ 1 25 cm The oscillator used employs a special type of thermionic tube with a split anode The tube is placed in a strong magnetic field and the frequency of oscillation depends primarily on the time of transit of the electrons between cathode and anode The frequency may be varied over a small range by changing the magnetic field and the circuit voltages There is a small Lecher wire system inside the vacuum tube The spectrometer has an echelette grating of 18 elements and concave mirrors for focusing the waves which are detected by an untuned crystal detector at the focus of one of the mirrors

Electrical Measurement of Small Vibrations In the report of the Aeronautical Research Institute Tokyo Imperial University (No 103 Feb 1934) there is an interesting paper by J Obata S Morita and Y Yoshida describing an electrical method of measuring small vibrations and its application to the measurement of the vibrations of airscrew blades The electrical arrangement used comprises an electrical circuit containing a triode An oscillation with a frequency of about 600 000 cycles per second can be started in the circuit The displacement or vibration to be measured is made to produce a corresponding change in the anode current of the vacuum tube and this change is recorded by an oscillograph The novelty of the method is its extremely high sensitivity and the fact that there is no need to bring anything into contact with the moving body It is known that the vibration of the screw blades is one of the factors affecting the sound emitted The positions of the loops and nodes were determined for model airscrews and al[illegible]r an actual airscrew Oscillograms are shown for the vibrations of the blades for given striking and measuring points Fairly good agreement between the observed and the calculated values is obtained The most conspicuous feature observed in the records of the vibrations of blades is a remarkable beat which is especially prominent in the case of metallic airscrew models It was found that a slight change in the manner of clamping the airscrew model gave rise to marked changes in the number of beats produced per second The beat is undoubtedly produced by the coupled vibration of the two blades The degree of coupling is altered by changes in clamping It is interesting to note that when a four bladed airscrew model is vibrating then at the instant of the downward stroke of one of the blades the ends of the three remaining blades spring upwards

Multiplet Intensities in Stars Mr A D Thackeray has described an investigation of multiplet intensities in thirty stars in the late types *K5* and *M* (*Mon Not Roy Ast Soc* Dec 1933) His work which was carried out with the full spectrophotometric method confirms the results reported by workers at Yerkes Observatory who had announced that visual estimates of line intensities demonstrated the existence of anomalies in certain multiplets The relative intensities of the lines in a multiplet as they appear in a stellar spectrum do not agree with the theoretical values which have been confirmed by laboratory experiments The effect in solar multiplets was first reported by Minnaert and independently by Woolley A great deal of argument has been directed towards examining the cause of the anomaly so far without arriving at any conclusive result Thackeray discusses some of these arguments in the paper under review The Solar Physics Observatory Cambridge at which Thackeray carried out the work is to be congratulated on being amongst the first observatories to produce finished results of stellar spectrophotometry on narrow absorption lines with a slit spectrograph

Plate Efficiency in Fractionating Columns A paper was read by Mr A J V Underwood before a joint meeting of the Institutions of Chemical Engineers and Petroleum Technologists on March 21 dealing with the determination of plate efficiency in fractionating columns with complex mixtures The essence of the paper was an evaluation of individual plate efficiency which is generally taken as the ratio of change in composition of the vapour effected by a plate in the column to the change in composition which would result if the vapour after passing through the plate were in equilibrium with the liquid on it It was claimed that this efficiency could be calculated for each component of the mixture knowing the composition of the vapour below and above the plate the composition of the liquid on the plate and the composition of the vapour that would be in equilibrium with that liquid From the above it would seem that to obtain these data for any given fractionating column would involve numerous analyses of liquids and vapours in contact with every plate but the author showed that it is only necessary to determine liquid compositions leaving vapour compositions to be calculated by the use of material and thermal balances The assumption that an efficiency of the order of sixty to seventy five per cent is to be expected in practice was not supported by much available experimental data ; probably this efficiency is seldom attained and if it is on the low side then there is considerable scope for progress in modification of plate design

The Explanation of Supraconductivity

IT is customary to describe the supraconductive state of a metal by setting its specific electric conductivity σ equal to infinity I wish to direct attention to another possibility namely that the supraconductive state can be described much more adequately by setting equal to infinity the *dielectric constant* ε of the substance its conductivity σ remaining finite or even becoming equal to zero

The actual meaning of the new definition can be seen from a comparison of the mechanism of ordinary electric conduction (σ finite) and ordinary polarisation (ε finite) In the former case the electrons called free move *independently* the conduction current being constituted by a drift motion due to the action of an external electric field and superposed on the unperturbed random motion of the individual electrons In the second case the electrons called bound are displaced by the electric field simultaneously in the same direction the polarisation current being due to an orderly collective motion of all the electrons Under normal conditions the displacement of the electrons with regard to the respective atoms remains small compared with the interatomic distances this corresponds to a finite value of the dielectric constant The assumption that the latter becomes infinite means that under the action of an infinitesimal field the electrons are displaced simultaneously over finite distances each of them passing successively from an atom to the next one like a chain gliding over a toothed track

Such a collective motion of the bound electrons will constitute an electric current just as much as the individual motion of the free electrons but a *polarisation* current rather than a *conduction* one The electrostatic mutual action of the electrons moving collectively in a chain like way will stabilise them against the perturbing action of the heat motion of the crystal lattice which will result in the permanence of the polarisation current after the disappearance of the electric field by which it was started[1] This permanence which has been erroneously interpreted as corresponding to an infinite value of the specific conductivity must be interpreted in reality as corresponding to an *infinite value of the dielectric constant* Now how is it possible to explain the occurrence of such an infinite value ? This turns out to be a very simple matter the appropriate mechanism having been considered already by Hertzfeld who however failed to give it the correct interpretation Consider a chain of equally spaced atoms with a polarisation coefficient α This means that an isolated atom assumes under the action of an external field E an electric moment $p = \alpha E$ If the field E is acting in the direction of the chain then in computing the polarisation of a certain atom we must add to it the field E produced by all the other atoms in virtue of their induced electric moments All these moments being the same we get

$$E = \frac{2p}{a^3} 2 \sum_{n=1}^{\infty} \frac{1}{n^3} = 4\ 52 \frac{p}{a^3}$$

and consequently

$$p = \alpha \left(E + 4\ 52 \frac{p}{a^3} \right)$$

whence

$$p = \frac{\alpha E}{1 - 4\ 52\, \alpha / a^3} = \alpha\ E \qquad (1)$$

We thus see that with a finite value of α for an isolated atom an infinite value of the effectiv polarisation coefficient α for the atom chain obtained if

$$4\ 52\, \alpha \geqq a^3 \qquad (2)$$

The sign > corresponding to a negative value of α need not be distinguished from the sign = in both cases the atom chain is characterised by th instability of the electron chain connected with it This instability which has been noticed previously by Hertzfeld was interpreted by him as an indication of the fact that the electrons no longer remain bound but become free conduction electrons Thus the inequality (2) was considered as characteristic of the metallic state in general I believe that it is characteristic not of the metallic state but of th supraconductive state a supraconductor being rather a dielectric with freely movable electron chains (that is with ε = ∞) than a metal

According to a theory of the metallic state developed in a rather qualitative way by Slater[2] and recently greatly improved and generalised by Schubin[3] the normal conductivity of a metal is due to a *partial ionisation* of the atoms a certain fraction s of all the atoms becoming positive ions and an equal portion (to which the corresponding electrons are attached) negative ions If these electrons are bound very weakly they may be considered as free in the usual sense of the word The conductivity of a metal is equal to the sum of the conductivities du to these free electrons or negative ions on one hand and the positive ions or holes on the other The mechanism of electrical conduction consists in the *individual* jumping of an electron from a negative ion to one of the neutral atoms surrounding it (which is thus converted into a negative ion) or from a neutral atom to a positive ion which thus becomes a neutral atom its rôle being switched over to th donor We meet with the same type of electric conduction in electronic semi conductors[4] The chief distinction between a metal and a semi conductor consists in the fact that in the former case $s > 0$ at the absolute zero of temperature (T) whereas in the latter case $s = 0$ at $T = 0$ increasing according to the Boltzmann equation ($s = ce^{-W/kT}$ where W is the ionisation energy) with the temperature

The elements which are likely to become supraconductors form an intermediary group in the sense that at ordinary temperatures they are relatively poor conductors like the ordinary semi-conductors the dependence of their conductivity on the temperature is however of the same character as that of typical metals (negative temperature coefficient) This means that in the case of these intermediary elements or half metals we have to do with substances which are characterised by a practically constant value of the ionisation fraction s Their small conductivity can be explained either by a small value of s or by a small mobility of the individual electrons (which seems the more probable alternative in view of the correlation between supraconductivity and the Hall effect discovered by Kikoin and Lasareff) The fact that, in ordinary circumstances, that is above the 'transition temperature' T_s these substances are not supraconductive can be explained by the finite value of their dielectric constant as determined by the polarisability of ions stripped of the conduction electrons The nature of the transition which takes place when the temperature T is decreased below T_c can thus be very simply interpreted by assuming that at this temperature s suddenly falls from a certain rather high value to *zero* and that the polarisation coefficient α of the resulting *normal* atoms with their full complement of bound electrons satisfies the inequality (2)* The very fact that the substance loses its conductivity (σ falling to zero along with s) thus transforms it from a metal into a dielectric with $\varepsilon \to \infty$ that is it becomes a supraconductor

Both the necessity and the sharpness of the transition $s \to 0$ (that is $\sigma \to 0$ and $\varepsilon \to \infty$) can be easily understood if we assume that the state $s = 0$ has a smaller energy than the state $s > 0$ It results from Slater s and especially from Schubin s calculations that the *lowest* energy level for polar (ionic) states *may* correspond to a *finite* value of s whether this lowest level lies below or above the energy level corresponding to $s = 0$ It can further easily be seen that the distance between the successive levels in a band of levels corresponding to a given value of s is very small compared with kT even for extremely low temperatures (of the order of a few degrees K) If further the *total* width of the band was also small compared with kT the entropy of the state $s > 0$ could be calculated as $k \lg g$ where g is the statistical weight of the whole band that is the number of ways in which the state s is realised Taking all possible distributions of the ns electrons (negative ions) and ns positive holes (positive ions) between the n atoms we get

$$g = \left[\frac{n}{(ns)\,(n - ns)}\right]^2$$

The transition $0 \to s$ is thus connected with an *increase* of entropy

$$\Delta\eta = 2k[n \lg n - ns \lg ns - (n - ns) \lg (n - ns)] \quad (3)$$

In reality the width of a band is of the order of 1 volt and therefore at least a thousand times larger than kT at the transition point This will result in a much smaller entropy increase $\Delta\eta$.

So long however as $\Delta\eta > 0$ it follows that the state $s = 0$ must be stable at low temperatures and the state $s > 0$ at higher ones

The transition temperature T_c as determined by the equality of the free energies of the two states is given by

$$T_c = \frac{\Delta\varepsilon}{\Delta\eta} \quad (\Delta\varepsilon = \varepsilon_s - \varepsilon_0) \quad (4)$$

Taking $s = \frac{1}{2}$ (which is probably an exaggeration) and calculating $\Delta\eta$ with the help of (3) we get $\Delta\eta = 1 \cdot 7k_B$ If $T = 4°$ (say) the transition energy $\Delta\varepsilon$ should be of the order of 14 small calories per gram atom This value is greatly reduced if the width of the energy band under consideration is large compared with nT its effective weight being accordingly small compared with g

We thus see that the second condition for supraconductivity is expressed by the inequality $\varepsilon_s > \varepsilon_0$ at $T = 0$ But this is not all Equation (1) is a good approximation so long as the chain like displacement of the electrons x is small compared with the interatomic distance a When x approaches $\frac{1}{2}a$ the electrons are pushed back by a force which varies more rapidly than the first power of x and can be overcome through the quantum mechanism of the tunnel effect If a large number of electrons N are moving together in a chain like way they behave like a particle with an N fold mass the transition probability being correspondingly reduced Now in his second theory of supraconductivity Kronig[5] has shown that a chain or as he puts it a linear lattice of electrons bound to each other in a quasi elastic way can be displaced through a periodic field of force (with a period a equal to the average spacing between the electrons) under the condition

$$h/b\sqrt{m} > a^2, \quad (5)$$

where h is Planck s constant m the mass of an electron and b is the rigidity coefficient of the electron lattice Putting $b = \tau e/a^3$[5] where τ is a numerical coefficient of the order 1 Kronig finds that the condition (5) is fulfilled if a is of the order of less than a few Ångström units This seems to show that a linear lattice that is chain of electrons is practically *always movable* with respect to the corresponding chain of atoms provided the condition (2) which is much more restrictive is fulfilled also In fact the latter condition seems to be the mathematical formulation of the possibility of treating the (bound) electrons as a kind of lattice I do not believe in the reality of the three dimensional lattices postulated by Kronig in his first paper He has himself shown that such lattices even if they exist could not be moved through the ionic lattice As a matter of fact one dimensional lattices or rather movable *chains* of bound electrons fully suffice for the explanation of supraconductivity Such chains need not be movable in all directions It is sufficient to assume that they should be movable in one particular crystallographic direction corresponding to the smallest spacing between the atoms the dielectric constant being infinite for this direction and preserving a finite value for all the others

In spite of its shortcomings Kronig s theory is certainly the nearest approach to the correct explanation of supraconductivity published hitherto, the present theory differing from it more in form than in essence The theory I advanced before which was based on the supposed stabilisation of the free electrons (against heat motion) by their *electromagnetic* action was wholly erroneous in this particular respect It was correct however in describing the motion of the electrons in the supraconductive state as an organised collective motion This led to the result that a metal must possess when in this state an enormous diamagnetic susceptibility This corollary subsists in the new theory and is corroborated by the fact recently discovered by Meissner that the magnetic permeability μ of a metal in the supraconducting state drops to zero A supraconductor can thus be described as a body with $\mu = 0$ and $\varepsilon = \infty$ its electrical conductivity σ in the exact sense of the word being either finite or even zero

A more complete account of the present theory will be published elsewhere

J FRENKEL

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* This inequality is probably satisfied for all metals, although not all of them are supraconductors because for true metals s remains finite (and practically constant) down to the absolute zero of temperature while for supraconductors it jumps to a finite value slightly above it.

[1] The effects of heat motion of the crystal lattice on the individual electrons are mutually cancelled Cf R Kronig *Z Phys* 80 203 1933

[2] *Phys Rev* 35 509 1930

[3] In the press

[4] Cf J Frenkel, NATURE, 132 312 Aug 26 1933

[5] *Z Phys* 80 203 1933

Flora of Tibet

THE plant collection made by Capt F Kingdon Ward in Tibet last year for the British Museum (Natural History) comprises about 750 items, and more than 5,000 specimens Some 500 species are included The bulk of the collection was made north of Rima (lat 28° 25 N, long 97° 0 E), in Zayul, south of the great snow range, and in Nagong north of the snow range The Nagong plants come from around Shugden Gompa (lat 29° 25 N, long 97° 0′ E)

The great range of snow mountains comparable to the Himalaya, and running approximately north west to south east, divides this part of Tibet into two South of this range, in Zayul the mountains are well wooded with deciduous and evergreen forest Oaks maples, birch, hornbeam magnolias, *Ilex* and *Rhododendron* species abound Higher up there is conifer forest North of the range in Nagong there is no forest and almost the only tree, found in a few favoured localities is *Picea lichiangensis* There is a number of shrubs especially species of *Lonicera Berberis Spiraea, Rosa Clematis* and *Cotoneaster* but chiefly the mountains are covered with a great variety of herbaceous plants Thus the snow range acts as a rain screen Amongst the most prominent alpine genera are *Gentiana, Primula Dracocephalum, Cremanthodium, Anemone* and *Androsace*

One of the principal results of the expedition was the definite recognition and delimitation of three floral zones in Tibet (1) the desert zone with very few species of flowering plants, (2) the outer plateau with a considerable alpine and a small woody flora, and (3) the river gorge country, divided into (*a*) upper gorge country with a large alpine flora and a few shrubs and trees (*b*) lower gorge country with a wealth of forest The discovery that the snow range is an eastern extension of the Himalayan range is also important from a phyto geographical point of view, as is also the observation that the glaciers on this range formerly extended a long way south Kingdon Ward has now been able to trace the southern limit of the ice during the last glacial epoch, from the eastern Himalaya right across to China, this advance of the ice had a profound influence on the flora

In Nagong where the snow line stands at about 19,000 ft, flowering plants in some variety were found above 18,000 ft, mostly, however, collections were made at 14,000–16 000 ft In Nayul, the snow line is lower most of the plants found in the Rima district were collected between 5 000 ft and 10,000 ft, a few alpines at 10,000–15,000 ft These last include several species of *Nomocharis*

One other type of flora requires mention—that of the deep Salween gorge, which was reached in August The heat was great the lack of water was conspicuous A peculiar flora of dwarf spiny or prickly shrubs occurs here (altitude 9,000–11,000 ft)

The southern country traversed is composed almost entirely of igneous rocks: the northern country almost entirely of sedimentary rocks, including limestones red sandstone and slate

On the return journey, the Mishmi Hills were crossed by a new route This country, being technically a part of Assam, falls within the Indian Empire, and few plants were collected there

In all, a number of new and little known plants were found, and the distribution of others, especially as between the Himalaya and Chinese mountains extended, though the most important results were the recognition of the several floral areas in Tibet and the proof of the Himalayan extension, with all that it implies in the distribution of plants in south east Asia Seed of about 180 species was secured also a number of photographs of plants in their natural surroundings

The regions which lie to the west of Shugden Gompa, between the Salween and the Tsangpo, still remain to be explored, before we can get an adequate idea of the flora of the river gorge country

Locust Control*

THE outbreak of locusts which began in the Sudan, Algeria and western Asia in 1926 and reached Kenya two years later, increased in intensity so greatly that it exceeded the powers of local checks and expanded rapidly into an enormous, widespread plague, ranging from Bechuanaland into Persia India and Turkestan It is estimated that the damage thus caused between 1927 and 1931 exceeds £6 000 000

The Government realised the significance and at once formed an organisation, which now appears in the form of the Locust Control Committee of the Economic Advisory Council, with headquarters at the Imperial Institute of Entomology, under the direction of Mr B P Uvarov

The work quickly became international Italy suggested a congress in Rome where war was declared upon the locust by an alliance of British Italian and French Governments, which have since been joined by the Belgian, Portuguese and Egyptian A striking illustration of the world wide interest in this war is seen in the list of works published during the period in question, which covers no less than 35 pages of the reports and includes papers in such unexpected languages as Chinese, Yiddish and Uzbeg, while there are 166 papers in Russian

The three species concerned are the desert locust *Schistocerca gregaria*, Forsk no doubt the same that plagued Pharaoh, the tropical form of the migratory locust, *Locusta migratoria*, L subsp, *migratorioides* R and F, and finally the red locust, *Nomadacris septemfasciata*, Serv The first is confined to the arid belt, and the great forests appear to offer a barrier even to flying swarms The migratory locust frequents the three types of savannah country, but is stopped by the deserts Its movements are due to reflexes dependent in temperate regions upon temperature, in hot countries upon humidity The life history of the migratory locust in the tropics is different from its cycle in the temperate zone, as the egg stage there is short but the adult long, so it is with the latter that the battle must be joined Spraying with poison dust from aeroplanes, particularly of the auto giro type, will probably be the solution, coupled with intelligence work in the home breeding areas, which are being investigated by four British, three French and several Indian entomologists

With the expansion of agriculture in Africa, the potential damage by locusts becomes vast indeed, but much valuable work has been done, and now that the organisation is in full swing, the outlook is encouraging M. B

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* The Locust Outbreak in Africa and Western Asia, 1925–31, and the same for 1932 Surveys prepared by B P Uvarov for the Committee on Locust Control of the Economic Advisory Council. (London H.M Stationery Office, 1933) 5s and 2s net respectively

University and Educational Intelligence

Cambridge.—It is proposed that the degree of Sc D *honoris causa* be conferred on Prof A Fowler, Yarrow research professor of the Royal Society

At Clare College, Mr R E Priestley has been appointed to a professorial fellowship

Oxford.—Dr R W T Gunther, Magdalen College, has been appointed University reader in the history of science The appointment, to which no stipend is attached, is for six years from August 1, 1934 No one in Oxford is better qualified than Dr Gunther to give instruction in the history of science, especially in its relation with the University His long series of volumes on "Early Science in Oxford", as well as his smaller treatises on the Daubeny Laboratory and the Botanic Garden, together with his work as curator of the Lewis Evans collection of scientific instruments are evidence of his power of making available his intimate knowledge of the subject

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The *New Commonwealth*, the monthly organ of a society for the promotion of international law and order, appeals, in a special educational supplement to its December number, to all engaged in education, to co operate towards the realisation of its aims The society stands for the establishment of an international tribunal of wider jurisdiction than the court at The Hague, and for an international police force, and this special supplement has articles by well known writers on 'Teaching Peace", "War and History", etc Simultaneously there appears in *School and Society* of December 9 a protest against premature agitations for organising the surrender to an international body of parts of the sovereignty of the modern State In an address to the Association of Urban Universities by the president of the College of the City of New York on the place of the State in the modern world, it is contended that it will be centuries before humanity is ready for a world commonwealth, and that the best agencies for conserving such communities of interest as exist among nations are the sovereignties joined in treaties and trade agreements

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Science News a Century Ago

Royal Geographical Society

"At the Anniversary Meeting, held on May 12, 1834, Mr W. R Hamilton, V P, in the chair, General the Right Hon Sir George Murray was re elected President, and Mr R I Murchison was elected a Vice President A report related that the Society had published, during the last year, the third volume of its *Journal*, in two parts, and a Map of America by Col Monteith; that the late African and Palestine Associations had dissolved themselves and transferred their funds to the Society, that the Royal Premiums for 1832 and 1833 were assigned to Capt John Biscoe and Capt Ross, and that the Council had subscribed 50l to a projected expedition into the interior of Africa from Delagoa Bay, and to another into the interior of South America—50l towards outfit, and 50l a year for three years It also noticed the formation of a branch society at Bombay Lieut Allen, the companion of the late Richard Lander, was present and exhibited a variety of his African sketches. A portrait of Lander, painted by Mr Brockedon, shortly before his departure, was presented by that gentleman to the Society. The Society have published the first part of Vol IV of their *Journal*" (*Gentleman's Magazine*, June 1834)

The first to receive the Royal Premium of fifty guineas (1832) was Richard Lander, for exploring the course of the Niger to the sea, next (1833), John Biscoe, for his circumnavigation of the antarctic continent and the discovery of Enderby Land and Graham Land Biscoe's voyage was chronicled only in the Society's *Journal*

The Padorama

The *Times* of May 12, 1834, describes an exhibition then on view at the Bazaar, Baker Street, London 'It consists of a continuous view of the railway and the adjacent country through which the line of road passes between Manchester and Liverpool The whole picture covers a surface of 10,000 sq ft of canvas and it is made to move on drums by mechanical power There is also a foreground detached from the principal painting which foreground is also moveable Along the railroad a great variety of waggons, carts, etc, attached to steam engines, are at intervals made to pass along This part of the exhibition was well contrived, the mechanism of the steam engines is accurately represented, and the pigmy passengers by whom the carriages are crowded might easily, so well is the deception of the whole effort preserved, be mistaken for living people of the full size of life"

Coins and Coining

On May 13, 1834, Mr William Wyon (1795–1857), the chief engraver at the Mint, delivered a lecture before the Society of Arts on 'Coins and Medals" in which he gave a sketch of ancient and modern coins, the progress of the art of coining and of modern medals After referring to the coins of the Greeks and Romans, and to the introduction of the various British coins, he said that one of the most important events in the history of the Mint in London was the introduction of the mill and screw Previous to the reign of Charles II, money was made by hammering slips of gold and silver to the proper thickness, then cutting the slips into squares, which were afterwards rounded and adjusted to the weight required After this, the blanks were placed between dies and struck with a hammer The mill and screw, or coining press, was invented in France, it is supposed by Antoine Brucher in 1553, and was first used in Great Britain during the Commonwealth At the Mint in 1834, there were eight presses, each press producing sixty pieces a minute In 1817 the daily production of coins was 343,000, while from January 4, 1817 until December 31, 1833 the sum coined in sovereigns and half sovereigns was £52,187,265 sterling One of the problems at the Mint was the selection of the best steel Fine steel as used by engravers was unfit for the purpose and coarse steel acquired fissures under the die press Even the best steel could be spoilt for want of skill on the part of the smith Casualties to dies were frequent but sometimes a pair of dies would strike three or four hundred thousand pieces The lecture was reported in full in the *Athenæum* of May 1834

Sir Charles Bell on the Brain

On May 15, 1834, Sir Charles Bell read a paper before the Royal Society on the functions of some parts of the brain and on the connexion between the nerves of motion and sensibility In the course of his paper he suggested that the best mode of inquiry into the functions of the brain and nervous system would be to trace the filaments of the nerves through the filamentary and striated substance of the brain and stated that the result of such an examination would show that two columns of motal and sensory nerves descend from each hemisphere of the brain and meet and decussate in the medulla oblongata He also entered upon a minute account of the medulla and of the various septa of nerves with which it is connected tracing the filaments upwards into the brain and downwards into the spinal column In concluding he remarked that the use of the cerebellum had not yet been determined with any tolerable degree of accuracy Bell at the time was surgeon to the Middlesex Hospital He had been admitted F R S in 1826 and in 1829 awarded a Royal medal for his discoveries relating to the nervous system

Death of H W Brandes

Prof H W Brandes who died at Leipzig on May 17 1834 was the first meteorologist to construct a series of daily pressure charts In his Beiträge zur Witterungskunde published at Leipzig in 1820 he discussed the weather over Europe of each day of 1783 He drew charts of equal deviation of pressure from normal and of wind direction these charts were not published and have been lost but a specimen chart was reconstructed by Hildebrandsson from Brandes material Brandes believed that the winds converged towards regions of rarefied air or low pressure In a later publication he discussed two cyclonic storms and demonstrated that they advanced from west to east across the earth s surface

In the year 1834 there was published the Narrative of a Voyage in the Southern Atlantic Ocean in H M Sloop Chanticleer in which W H B Webster gave what was probably the first printed account of the differences of average annual pressure between different parts of the world and attributed to these hitherto unrecognised differences the perpetual interchange and motions of the atmosphere

Belgrave Literary and Scientific Institution

Following the establishment of this institution at 30 Sloane Street the *Athenæum* reported in its issue of May 17 1834 the delivery of an opening lecture by Prof Robert E Grant whose subject was On the Nature Growth and History of Corals We read that there was a crowded and highly respectable audience and that the lecture was illustrated by a variety of beautiful specimens and diagrams also that the results of personal researches and ingenious experiments were detailed

Prof Grant who is referred to above was born in Edinburgh and was a graduate of the University there In his student days he was the frequent companion of Charles Darwin in excursions and walks Darwin (then) thought that he was dry and formal (Life) Grant contributed many papers to the *Edinburgh Philosophical Journal* and the *Memoirs of the Wernerian Society* In 1828 he took up duties in London as professor of comparative anatomy and zoology at University College and during forty six academic years never omitted a single lecture Appointed in 1837 he was for three years Fullerian professor of physiology at the Royal Institution By will Grant bequeathed his property collections and library to University College (*Roy Soc Proc* 23)

Societies and Academies

LONDON

Royal Society, May 3 W D WRIGHT The measurement and analysis of colour adaptation phenomena There is a main process of adaptation that operates through the regeneration of a photosensitive substance at a constant rate The instantaneous response aroused by a stimulus is directly proportional to the magnitude of the latter but owing to the process of adaptation the response is rapidly reduced to an approximately constant level This is the true interpretation of the constancy of the Fechner fraction as opposed to the suggestion that the response is proportional to the logarithm of the stimulus By locating the three hypothetical stimuli in the colour triangle corresponding to those sensations that can be modified in intensity but not in colour no matter what the colour of the adaptation may be it has been possible to determine the fundamental response or excitation curves R J LUDFORD Factors influencing the growth of normal and malignant cells in fluid culture media Significant differences have been found in the behaviour of different strains of tumours in mouse and rat serum Some tumours have not been grown as sheets of malignant cells in either mouse or rat serum other tumours have given good sheet growths in mouse serum but not in rat serum while still others have grown in both sera It is suggested that whether or not cells form sheets from explants in a fluid medium depends upon the adhesion of the cells to glass in that particular medium rather than upon growth promoting or growth inhibiting properties of the medium The presence of large numbers of active cells of the macrophage type interferes with sheet formation by malignant cells in fluid media This is regarded as due partly to crowding out of the malignant cell on the surface of the cover glass and partly to the phagocytic activities of the polyblasts It may be the activity of cells of this type accumulated around a tumour graft in an immune animal which prevents its growth

DUBLIN

Royal Dublin Society, February 27 J J NOLAN Observations of atmospheric electricity at Glencree The results for diurnal variation of ion content and rate of ion production in the lower atmosphere at Washington (Wait and Torreson) Canberra (Hogg) and Boston (Yaglou) were compared with those found at Glencree It is shown that there is considerable support for the view that the maximum in the rate of ion production occurs approximately simultaneously at these stations

PARIS

Academy of Sciences, March 12 (*C R* 198 997–1088) JEAN REY The working of a thermocompressor carrying successively two compressible fluids of different densities law of yield by weight law of invariance of the final pressure C CAMICHEL, L ESCANDE and G SABATHE The similitude of *ouvrages courts* with free surface DMITRI MORDOUKHAY BOLTOWSKOY Abelian integrals with reducible systems of periods J O STRUTT Hill s differential equation in the complex domain A RAUCH Remarks on holomorph functions in an angle and meromorph algebroids in the plane K NIKOLSKY The relativist quantic interaction RENÉ REULOS

A new method of integration of the equation of electromagnetic waves and its application to the physics of the electron Arcadius Piekara and Bruno Piekara The dipole moment of acetic anhydride and some anomalies presented by the acids of the fatty series G Déchêne Variations with time of the intensity of the current in a semi conducting substance submitted to a low electromotive force J Solomon The relativist theory of atoms with a large number of electrons Jean J Trillat Electronic diffraction by cellulose films By the use of monokinetic electrons the structure of various cellulose derivatives has been studied X rays give no results with these films A freshly prepared film is amorphous, after some hours very small microcrystals disposed at hazard appear After some days, or weeks, the entire film is crystallised and is formed of unique crystals G Liandrat Attempts at applying the laws of photoelectric emission to photo elements with an arresting layer R de Mallemann and P Gabiano The magnetic rotatory power of hydrogen selenide From the figure obtained, the value 36×10^{-4} is found for the atomic rotation of selenium, which is thus higher than that of sulphur, 23 5 L Décombe The influence of temperature on the yield of alternators and of transformers The use of a refrigerating machine for cooling is not worth while as the improvement in yield is so small Jean Amiel The action of chlorates on sulphur, selenium and tellurium A study of the conditions producing spontaneous inflammation of mixtures of chlorates of the alkaline earths with sulphur Marcel Chaussain and Henri Fournier The passivity of magnesium in solutions of chromic anhydride and its chemical scouring after corrosion The marked effect of the presence of impurities in the chromic acid, especially small amounts of sulphuric acid, is shown by experiment Malaprade The acidimetric method of determining formol and sulphites Tiffeneau, E Ditz and Mlle B Tchoubar Molecular transpositions in the dimethylcyclohexane series, with or without reduction of the ring, by the removal of halogen from the chlorhydrins and by isomerisation of the epoxides Ch Prévost, P Donzelot and E Balla The Raman effect, molecular refraction and constitution The supposed α benzylcyclohexene A repetition of the work of Auwers and Treppmann on the dehydration of phenylcyclohexylcarbinol from which the conclusion is drawn that the product is not α benzylcyclohexene but benzylidenecyclohexane P Vièles The dilactylic acids and their anhydride Mlle M Th François The setting of the *Aleurites* oils (China wood oil) by the halogen compounds of antimony H Brasseur, A de Rassenfosse and J Piérard The crystallographic study of barium nickelocyanide Hydrated barium nickelocyanide and barium platinocyanide are completely isomorphous D Schneegans The geological constitution of the Chabrières massif (Hautes Alpes) Michel Pertessis The radioactivity of the mineral springs of Greece Henry Hubert The general circulation of atmospheric air above Indo China R Bureau The direction of the summer sources of atmospherics L Eblé and G Gibault The values of the magnetic elements at the Val Joyeux (Seine et Oise) Station on January 1, 1934 D Barbier Theoretical remarks on the distribution of ozone in the atmosphere Paul Corsin The characters of *Grammatopteris Rigolloti* André Dauphiné The different modes of thickening of the membrane in vascular plants Luigi Manzoni and Agostino Puppo The transpiration of wheat as a function of climatic factors A Maublanc and L Roger A new rust of the coffee plant of the Cameroons This plant disease is clearly distinct from *Hemileia vastatrix* and is given the provisional name of *Uredo coffeicola* Ph Joyet Lavergne Cytoplasmic sexualisation in yeasts with heterogamic conjugation Et Rabaud and Mlle L Verrier The air bladder of the loach, *Cobitis barbatula* Y Le Grand Dazzle in yellow light Maurice Fontaine Absorption and fluorescence spectrography of fabreine Mme Andrée Drilhon Courtois The regulation of the mineral concentration of the internal medium in some Crustacea and their adaptation to changes in salinity Pierre Girard and Mlle Marguerite Lourau First indications on the nature and physical properties of an antibody electrophoresis of hæmolytic sera R Guillemet, C Schell and P Le Fur Fermentable glucides, alcoholic fermentation and gas production in bread making A W Sellards and J Laigret The duration of the immunity resulting from vaccination against yellow fever Experiments are described proving the immunity conferred by vaccination is of at least two years' duration

Sydney

Linnean Society of New South Wales, November 29 F A Craft The coastal tablelands and streams of New South Wales Some of the highland features form surfaces of greater or lesser relief which are not surrounded by higher country, while others consist of plains almost enclosed by higher land, with a sharp break of slope in the passage from lower to higher surfaces, in addition, the plateau edges are distinguished from the gentle regional slopes of the summit planes, and the growth of the plateau is traced by reference to relic scenery preserved by basalt flows The streams of the region are classified according to their approximation to profiles of equilibrium, and the extent of canyons along their courses Lilian Fraser The Mycetozoa of New South Wales Eighty eight species and varieties of Mycetozoa are listed, most of them from the environs of Sydney and the adjacent highlands Very few records are known for the western parts of the State probably due to the relatively hot and dry climate being unsuitable for their development Pearl R Messmer A new species of *Pterostylis* A new species of *Pterostylis* is described from Fitzroy Falls, N S W It suggests affinities with *P grandiflora*, *P ophioglossa* and *P reflexa* and may have originated as a hybrid between the first two of those species G A Waterhouse Australian Hesperiidæ (4) Notes and descriptions of new forms Nine new races are described As the result of an examination of type specimens in the British Museum by Brigadier W H Evans, it is shown that *Taractrocera anisomorpha*, Lower, and *T ina*, Waterhouse, are full species and not races of species found in Timor and New Guinea Further notes are given on *flavovittata*, Latreille, and this species and its allies are now placed in *Ocybadistes*, Heron, instead of *Padraona*, Moore The remarkable life cycle of two years of *Hesperilla chaostola*, Meyrick, is described

Vienna

Academy of Sciences, January 11 Elisabeth Kara Michailova Nuclear γ radiation excited artificially A large number of elements were subjected to intense radiation with α particles of polonium to ascertain to what extent they emitted a hard nuclear γ radiation under such treatment Positive results were shown by B N Al Na Mg and especially Be **Herbert Haberlandt Berta Karlik** and **Karl Przibram** Synthesis of the green low temperature fluorescence of fluorite Ytterbium is found to be the source of this fluorescence **Hermann Wendelin** Abel s groups **Alexander Köhler** and **Wilhelm Freh** Geological petrographic studies on the igneous rocks of the Lower Austrian forest region and its neighbourhood (3) Results are given of analyses of granite from Schrem quartz mica-diorite from Gebhart and kersantite from the Loja valley above Steinbruch **F Grüter A Staheli** and **E Steinach** Removal of sterility from animals (oxen cows pigs) by the female sexual hormone A single administration of this hormone suffices to render sterile animals capable of breeding **Alfred Müller** Baire s theorem **Rudolf Wagner** Prefloration polymorphism and polygamia in *Reineckea carnea* (Ardr) Kth

Jan 18 **Herbert Haberlandt** Fluorescence analysis of minerals The presence of rare earths in certain scheelites and zircons and that of uranium in certain scapolites is detectable by means of the fluorescence spectrum **Robert Schwinner** Geology of Eastern Styria (1) structure of the mountains about Vorau **Hans Przibram** (1) Skeletal transitions in regenerating *Sphodromantis* antennæ (2) Skeletal transitions in regenerating cricket antennæ **Heinz Trampusch** Influence of endocrine glands on the regenerate in vertebrates

Jan 25 **Friedrich Kümel** Crystalline facies in the Rosalien mountains eclogite and amphibolite **Karl Przibram** Plasticity and hardness of alkali halide crystals (2) The author s results are compared with those obtained by other methods by Reis and Zimmermann and by Goldschmidt **Elisabeth Kara Michailova** Luminous intensity of the air caused by α particles of various ranges The variation of intensity with the range of the α particles follows a course similar to that of the ionisation curve **Otto Wettstein** Results of the Austrian biological expedition to Costa Rica in 1930 Amphibia and reptiles **Gustav Götzinger** and **Helmut Becker** New geological stratigraphic investigations in the Wienerwald

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday May 14

Royal Geographical Society at 8 30 —W Rickmer Rickmers Ajaristan and Lazistan

Tuesday May 15

Institute of Physics at 4 15 —(at the Royal Institution Albemarle Street W 1) —Annual General Meeting Sir Henry Lyons Physics and Science Museums' (Presidential Address)

Bedford College for Women at 5 15 —Dr Werner Brock Introduction into Contemporary German Philosophy (succeeding lectures on May 16 and 18)*

Gresham Lectures in Astronomy at 6 —(at Gresham College Basinghall Street E C 2) Arthur R Hinks 'Times Dates and Calendars (succeeding lectures on May 16 17 and 18) *

Wednesday, May 16

Royal Meteorological Society at 5 —Dr G C Simpson World Climate during the Quaternary Period

Faraday Society at 5 30 —(at the Royal Institution Albemarle Street W 1) —Sir William Bragg Molecule Planning (Spiers Memorial Lecture)

Royal Society of Arts at 8 30 —Dr C E Kenneth Mees Some Photographic Aspects of Sound Recording (Sir Henry Trueman Wood Lecture)

Thursday May 17

London Mathematical Society at 5 —(in the rooms of the Royal Astronomical Society Burlington House W 1) —Prof E A Milne World Gravitation by Kinematic Methods

Friday May 18

Bedson Club Armstrong College Newcastle upon Tyne at 6 30 —Prof G G Henderson Gutta Percha Balata and Caoutchouc (Twenty sixth Bedson Lecture)

Royal Institute of Public Health May 15–20 —Annual Congress to be held at Norwich Alderman H N Holmes president

Association of Teachers in Technical Institutions May 19–22 —Twenty fifth conference to be held at Middlesborough

Official Publications Received

GREAT BRITAIN AND IRELAND

Imperial Bureau of Animal Genetics A Bibliography of the Works of James Cossar Ewart Compiled by Dr J H Ashworth and Dr F Fraser Darling (Supplement to Animal Breeding Extracts Vol 1) Pp xi (Edinburgh and London Oliver and Boyd) 6*d* net

Report by the Hydrographer of the Navy on the Surveys carried out by H M Naval Surveying Service and on the Work of the Hydrographic Department for the Year 1933 Pp vi (London Admiralty)

Memoirs of the Cotton Research Station Trinidad Series A Genetics No 6 (a) Further Experiments on the Inheritance of the Crinkled Dwarf Mutant of *G barbadense*, by S C Harland (b) Two Interspecific Hybrids between Asiatic and New World Cottons by A Skovsted Pp 30 2*s* 6*d* Series A Genetics No 7 The Inheritance of Leaf Shape in Asiatic *Gossypiums* By J B Hutchinson Pp 78 2*s* 6*d* (London Empire Cotton Growing Corporation)

OTHER COUNTRIES

The Journal Hyderabad Geological Survey Vol 2, Part 2 Water Supply Paper No 1 Geology of the Underground Water Resources of the Hyderabad State and Notes on Well Sinking By Capt Leonard Munn Pp vii+204+16 plates (Lingsugar Hyderabad Geological Survey) 5 rupees

Proceedings of the Sugar Cane Investigation Committee. Vol 4 Part 4 Progress Reports for July to December 1933 Pp 201 254 (Trinidad Imperial College of Tropical Agriculture.)

Commonwealth of Australia Council for Scientific and Industrial Research. Bulletin No 77 Studies on the Phosphorus Requirements of Sheep 1 The Effect on Young Merino Sheep of a Diet deficient in Phosphorus but containing Digestible Proteins and Vitamins By Sir Charles J Martin and A W Peirce. Pp 44+2 plates Bulletin No 78 Methods for the Identification of the Light-coloured Woods of the Genus Eucalyptus By H E Dadswell, Maisie Burnell and Audrey M. Eckersley (Division of Forest Products Technical Paper No 12) Pp 60+41 plates (Melbourne Government Printer)

The Wistar Institute Style Brief a Guide for Authors in preparing Manuscripts and Drawings for the most Effective and Economical Method of publishing Biological Research Pp 160 (37 plates) (Philadelphia Wistar Institute) 2 dollars

Jahresbericht der Hamburger Sternwarte in Bergedorf für das Jahr 1933 Pp 21+4 plates. Zweites Bergedorfer Sternverzeichnis 1930 0 enthaltend die mittleren Örter von 4590 Sternen (Eros-Anhaltsternen 2 Ordnung für die Opposition 1930–31) nach photographischen Aufnahmen mit dem AG Astrographen in den Jahren 1930 und 1931 Herausgegeben von Dr Richard Storr Pp vi+78+1 plate. Sammlung von Hilfstafeln der Hamburger Sternwarte in Bergedorf. 2 Formeln zur geographischen Ortsbestimmung (zum Gebrauch beim Astronomischen Praktikum an der Hamburgischen Universität) Pp ii+14 H Formeln und Hilfstafeln zur Reduktion Photographischer Himmelsaufnahmen Teil 2 Pp iii+64 (Bergedorf Hamburger Sternwarte)

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Milk Production and the Farmer

IN an interesting speech delivered at the Taranaki Agricultural Society s Show on March 8 Lord Bledisloe Governor General of New Zealand discussed the questions of the proposed dairy products quota to Great Britain and the removal of the embargo on the importation of pedigree live stock from Great Britain Lord Bledisloe pointed out that while the British farmer must insist that the dairy industry should be made a paying proposition there is at the present time on the British market much imported foreign third grade dairy produce which is causing the slump in prices It was agreed at Ottawa that subject to the salvation from ruin of her own dairy farmers Great Britain would not stand by and allow New Zealand farmers to suffer permanent impoverishment either in dairy farming or in any other branch of husbandry The future of the Dominion depends upon its successful and progressive methods of pastoral husbandry and while the standard of quality in New Zealand produce is already very high it is being still further improved by scientific methods

The case for the removal of the embargo on the importation of live stock from Great Britain rests on the necessity for the introduction of fresh blood in those breeds of cattle and pigs in which the numbers in New Zealand are low and inbreeding prevalent At present the cost is prohibitive through unnecessary detention in some other country *en route* the risk of infection is small because of the short incubation period of foot and mouth disease and the long journey to New Zealand High quality in her produce is the first essential to success and New Zealand can afford no longer not to import pedigree animals direct from Britain and thus improve her live stock as her rivals are doing

The question of the proposed dairy products quota and the apparently conflicting interests of New Zealand and British dairy farmers which at the present time appear to threaten the existence of either one or the other have an important bearing on present day questions of milk production in Great Britain Both countries are ideally situated climatically for dairy production Up to the present time the British farmer has looked to liquid milk consumption as the outlet for his supplies, while the New Zealand farmer, being a long way from the market, has produced mainly butter for export Beef prices being so bad recently large numbers of British farmers have changed over from beef to milk production and now there is a large amount of milk which is surplus to the present requirements for liquid consumption

The question arises whether a quota should be put on New Zealand butter and the surplus British milk used for butter making In our opinion this would be wrong Under British conditions of high costs of production butter making on a large scale is not a paying proposition If the price of butter is raised by quota restrictions to the level at which it will pay British farmers to produce it then we shall see a return to the consumption of margarine by the poorer classes of the community From a nutritional point of view this is undesirable

What then can be done with the surplus milk now being produced in Britain ? In addition to immediate action with regard to beef prices—something perhaps rather more drastic and simple than the Fat Stock Commission s recent report visualises—a large portion if not the entire present surplus could be consumed as fresh liquid milk and thin cream (16–20 per cent fat) if our public could be persuaded to consume as much milk *per capita* as does the average American

No milk publicity campaign however will persuade the British public to consume more dairy products unless it shows them how this can be done There is a limit to the amount of milk which one can take as milk puddings But the thin cream market is virtually untapped The only choice open to the housewife between whole milk and the type of cream that almost defies extraction from its carton is the cream that rises to the top of the milk bottle or some tinned substitute Few people accustomed to thin cream in tea and coffee and as an accompaniment to puddings porridge fruit and breakfast cereals would give it up unless forced to do so A demand for this commodity stimulated among the middle and upper classes would suit the farming community very well for it would leave skim milk on the farms for pig feeding—a supplementary protein feed which is badly needed to assist quality of the carcase of pigs sold under the Bacon Pig Marketing Scheme Danish bacon produced without skim milk would lose its characteristics

The large American consumption of milk however is mainly brought about by the city office workers consuming milk with their light lunch whereas the British take tea or coffee It is by serving milk attractively in bottles off ice that the American has been persuaded to drink it Tepid milk as it is too often served in Great Britain is not a clean drink and does not quench the thirst as iced milk does like cocoa tepid milk leaves a thick taste in the mouth so in the absence of iced milk the British public prefer a clean drink like tea or coffee for lunch Stimulation of the consumption of the surplus milk in Great Britain in these ways—iced milk and thin cream—would not only be more profitable to the British farmer and avoid doing injury to the business of the New Zealand farmer but would also be to the nutritional advantage of all classes of the British community

Leadership in Local Government*

THE very attention which the growing complexity of the problems confronting the administrator whether in national or industrial life has attracted makes it easy to overlook the extent to which technical factors have become important in local government also In the last twenty years the powers and duties of local authorities have greatly increased They have now far reaching responsibilities and the welfare of the community is largely dependent on the efficiency with which those responsibilities are discharged Public health education housing town and country planning road construction and maintenance—these are only some of the activities of local government authorities and more and more they require to have at their disposal officers on whom they can rely fully both for advice on the critical questions which come before them and for the execution of their decisions when taken

The local government service in Great Britain maintains a high standard for which no small share of the credit is due to the National Association of Local Government Officers This and other associations have laboured to secure improved qualifications of their members and have succeeded in developing an invaluable professional spirit and outlook In spite of this there are wide variations in the standards of recruiting and training of officers for local government service No consistent efforts are made by local authorities as a whole to secure the best persons for their service and to make the best use of them Recruitment is often haphazard and training is unsystematic Although technical qualifications where held are usually fairly high not all the qualifications are entirely satisfactory, and thorough investigation of the field is required

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* Ministry of Health Report to the Minister of Health by the Departmental Committee on Qualifications Recruitment Training and Promotion of Local Government Officers Pp 91 (London H M. Stationery Office 1934) 1s 6d net

Investigation of the technical qualifications of local government officers was excluded from the scope of the recent inquiry into the qualifications, recruitment, training and promotion of such officers carried out by a Departmental Committee of the Ministry of Health under the chairmanship of Sir Henry Hadow, but the report none the less discusses a number of important factors bearing on the training of administrators competent to deal with the many important technical issues involved in local government service While the Committee recognises the importance of appropriate technical and professional qualifications in the principal departmental officers, it points out that the functions of any chief officer of a major department are mainly administrative, and it is of opinion that, in the past, local authorities have not laid sufficient stress on the administrative qualifications

The essential problem in local government to day is to ensure that the service offers an attractive career for vigorous minds and strong personalities Methods of recruitment, training, grading, promotion and remuneration are of importance as they contribute to this primary purpose The satisfaction of this end indeed offers the only adequate safeguard against incompetence or corruption in the public service, and is accordingly an essential factor in the redemption of the politician from his low position in public esteem and in the restoration of confidence in democratic institutions

Among the factors which promote the supply of administrators of the requisite quality, recruitment on a wider basis is essential, and for this reason the Committee insists not merely that local authorities should draw their professional and technical officers from all available sources, whether within the service or without, but also that difficulties in the way of recruiting university graduates without technical qualifications must be overcome No source of supply of the rare and invaluable quality of leadership can safely be neglected, but it is equally important to remember that administrative powers can be developed by training and experience The recommendations that deliberate efforts should be made to arrange to give promising young officers practical experience in administration and to encourage the study of the principles of public administration are vital

The report is happily free from the suggestion that technical and scientific officers as a class are lacking in administrative ability It is recognised that individuals of high professional or technical standing may be lacking in this quality, it is therefore the more important to recognise it and develop it where found The report outlines principles which are fully as valid in industry or in the Civil Service as in local government service, whereby the requisite combination of technical knowledge, professional integrity and administrative capacity may be encouraged and brought to bear on the complex problems of to day Its recommendations for centralisation and unification of the service, like those bearing on promotion and remuneration, are significant so far as they contribute to the main purpose of creating a service which compares sufficiently well with those obtaining in private enterprise to secure a proportion of the ablest minds and strongest characters of each generation

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Chemical Factors in Plant Growth

Croissance des végétaux Par Dr Albert Demolon (*Principes d'agronomie*, Tome 2) Pp ix+307 (Paris Libr Dunod, 1934)

DR DEMOLON is well known as one of the clearest thinkers and one of the most ingenious minded among agricultural investigators As chief scientific advisor to the French Ministry of Agriculture he is kept in close touch with the practical problems of the French farmer, and as head of the research laboratories at Versailles he is equally closely associated with modern movements in science In his earlier publication, "La Dynamique du Sol", he dealt with the formation and composition of soils and the changes occurring therein, in the present volume, which is by way of a continuation, he discusses the relations between the soil and the growing plant, the subject which as he truly points out is the foundation on which rests scientific agriculture

In the first section of the book the author discusses the physical factors determining plant growth the effects of light, of temperature, electricity and of various rays also the amplitude of variations in yield due to meteorological conditions

The greater part of the book deals with the chemical factors concerned in plant growth the atmosphere, nitrogen and the mineral elements. The author sets out the facts clearly and discusses them with considerable penetration He has the happy power, common to the best French writers, of choosing the words that best express his ideas, and of saying what he has to say clearly, tersely and accurately

A useful summary is given of the part played by mineral elements other than the nitrogen, phosphorus and potassium which for long were the only substances considered to have fertiliser value The standard fertilisers for many years past have in point of fact supplied other elements superphosphate contains about 50 per cent of gypsum , the usual potassic fertilisers contain sodium or magnesium or both basic slag contains iron manganese and other elements In ordinary practice therefore, farmers have been adding compounds of calcium, magnesium, sodium iron, manganese, sulphur and chlorine along with the nitrogen potassium and phosphate But with recent improvements in technical chemistry, it is no longer necessary to use crude salts as fertiliser, and some of the new concentrated fertilisers attain a degree of purity hitherto unapproachable in agricultural practice The question is now beginning to interest agricultural experts whether they should advise farmers to add deliberately to their soils some of the substances they have been adding only incidentally It seems certain that in absence of these various elements, plant growth becomes abnormal and certain so called physiological diseases are likely to be induced This subject has been studied at the Institut Pasteur, Paris, at Rothamsted, the Waite Institute, Adelaide, various United States experiment stations and elsewhere The author deals at some length with magnesium, which is now attracting some interest in France Additions of manganese and boron to the soil seem to be necessary in certain cases, otherwise definite disease symptoms appear, but Dr Demolon is less certain about the need for adding some of the other elements which refined water cultures show to be necessary

Another subject now attracting much attention among agriculturists and discussed at length by the author, is the possibility of toxin formation in soils Some substances, hydrogen sulphide for example, are readily formed in anaerobic conditions others, such as excess of soluble salts, may be brought in from outside, for example, by sea floods Plant roots were at one time supposed capable of excreting substances toxic to themselves if not to others, then the idea was dismissed , but Pickering's work at Woburn shows that there may be something in the old idea, and H G Thornton at Rothamsted has shown that lucerne seedlings certainly excrete something that stimulates bacterial development in the soil and that might therefore have some effect on other plants The author summarises the facts clearly and concludes that no definite pronouncement can yet be made on this difficult subject

After an interesting and succinct account of the relations of soil micro organisms and plant growth, the author proceeds to summarise the present position in regard to the quantitative expression of plant growth phenomena by curves and equations He discusses in the first instance the qualitative changes, the seedling stage rapid vegetative growth, and maturation , these are not separated in point of time and at no time is the plant simply adding to its substance The simpler formulæ put forward to express the relation between the supply of nutrients and the extent of growth are none of them satisfactory though some of them may be sufficiently approximate to serve as a rough guide in fertiliser practice Here too the author adopts a cautious reserve and prefers to await the result of further experiment before making too definite a pronouncement

We can cordially recommend the volume to the student, both on account of its matter and of its presentation E J RUSSELL

Celestial Mechanics

Planetary Theory By Prof Ernest W Brown and Prof Clarence A Shook Pp xii+302 (Cambridge At the University Press, 1933) 15*s* net

THERE are various definite theorems bearing on the impossibility of solving the problem of three (or *n*) attracting bodies What is certain in a practical sense is that no general solution is attainable in a form suitable for comparison with observations even for a limited interval of time

Special methods have been devised for the two distinct types of motion which are present in the solar system, the motion of the planet and the motion of the satellite In the latter case, when the satellite is identified with the moon, there results a problem of quite special character and quite extraordinary complexity At the same time, it is essentially a single problem not lending itself naturally to piecemeal treatment Adams, it is true, succeeded in discussing some of its leading features in an elementary way, besides obtaining some original results of value in theory and method G W Hill again laid the foundations of a new theory without pursuing the subject beyond the preliminary stage But in general the lunar theory is a theme for the specialist prepared to make it his life s work Such a devotee was found in Prof E W Brown who has had the satisfaction of seeing his vast undertaking completed in every detail Now with a collaborator he has brought his experience gained in the more special field to bear on the wider and more varied problem of planetary motion

The design of the present work is very different from that of the treatise on the lunar theory for which a generation of students has been indebted to Prof Brown There he reduced to an orderly scheme all the methods of proved value in the development of the subject Here the ultimate object is the production of a general theory as required for comparison with observation in the various cases which arise Practical methods marked by an underlying unity are developed with this aim in view No attention is given to the history of the methods or to such theoretical aspects of the subject as those with which Poincaré concerned himself These can be found elsewhere There is an austere suggestion about this book that traffic ought to be confined to the public highway and that stragglers along the bypaths ought not to be encouraged The authors have certainly done much to consolidate the main road and even the inveterate rambler will appreciate their good work

Elementary chapters provide a sufficient introduction for the reader who has no previous acquaintance with the subject In a later chapter the direct calculation of the co-ordinates in terms of the true orbital longitude as independent variable is treated by an advantageous modification of a method given by Hansen Apart from this the work is based mainly on the use and transformation of elliptic elements There is a very valuable section on the disturbing function and its derivatives developed by various methods The use of canonical equations with the allied transformation theory is very clearly explained Thus it is shown that the terms of short period can be separated and removed by a single process and in the case of disturbing planets with periods unrelated to that of the body considered the problem of the motion presents comparatively little further difficulty

The first approach to more difficult conditions was found in the case of the long inequality of Jupiter and Saturn arising from the nearly commensurate periods of the two planets But problems of a completely different order are offered by the minor planets when the periods stand in a simple ratio to that of Jupiter within limits which amount to resonance Criteria for these limits are investigated with particular detail for the ratio 1/2

The Trojan group of asteroids have the same period as Jupiter and to these the final chapter is devoted The peculiar feature of their orbits is a long period libration in longitude It becomes necessary to introduce non integral powers of the mass of the controlling planet and the disturbing action of Saturn is so modified by the presence of Jupiter that separation of the effects is impossible and the problem becomes necessarily one of four bodies This feature has been familiar in the planetary perturbations of the moon it is a new circumstance in planetary theory The discussion of resonance and the treatment of the Trojan group of planets constitute the most original parts of the present work and will be found most interesting as well as valuable

Remarks on the limitations to be attached to certain familiar results relating to the stability of the planetary system will be found at several points and they are no doubt just But it is a little hard to see the mean distance dethroned from its place as a linear parameter of special character Naturally it owes this position in spite of its name not to any mean or average property but to its occurrence in the simple statement of Kepler s third law That point however has not been overlooked (see p 67) or the necessity for strict definitions to which it is allied In the third equation on p 216 there is a slip (of little importance) not noticed in the errata

It should be added that this valuable work has been admirably produced at a price which must be considered extremely moderate

The March of Inorganic Chemistry

A Text-Book of Inorganic Chemistry for University Students By Prof J R Partington Fourth edition Pp viii+1062 (London Macmillan and Co Ltd 1933) 15s net

A GENERATION or so ago inorganic chemistry appeared to have frozen into immobility and life in this field of science was easy and pleasant for both the author of an inorganic chemical textbook and his readers How different is the position to-day, when both writer and student can enter so whole heartedly into the feelings of the Gilbertian policeman ! So we find that in the twelve years succeeding its first publication, Prof Partington's treatise has had to undergo no fewer than three extensive overhauls in order to keep its readers reasonably up to date The subject still remains fluid , for, as the author remarks in his new preface "Very recent investigation of the structure of atomic nuclei will probably before long considerably amplify and modify present views on atomic structure, and the student who wishes to ascertain the current state of this investigation must follow the periodical literature "

In the new edition, Prof Partington has taken every care to keep his readers abreast of modern theory and practice in pure and applied inorganic chemistry, and the book retains its position as one of the best available for regular use by university students, and for reference by advanced pupils in schools There is no need to add here to the wide spread encomiums which Prof Partington's work has deservedly received , but attention may be directed to some outstanding alterations in the new edition The chapter on atomic structure has been reorganised so as to include a revised account of Werner's co ordination theory , newly found isotopes of hydrogen and other elements have been noticed , a tabulated list of the electronic structures of the rare earth elements has been added, as have also certain electronic formulæ , the account of active nitrogen has been revised , and there is a general discussion of hydrides These are straws showing the way the wind blows in inorganic chemistry at the present time The wise restraint which has been exercised in keeping the work, in true scientific fashion, "at constant volume" (1062 pp) is to be commended JOHN READ

Short Reviews

Biology in Everyday Life By John R Baker and J B S Haldane Pp 123 (London George Allen and Unwin, Ltd , 1933) 3*s* 6*d* net

THIS little collection of essays consists of six slightly modified talks broadcast in the spring of last year Five of them are by Dr Baker, and their scope is well indicated by the titles— A Biologist's View of Everyday Life Social Life in Animals" "The Determination of Sex ' The Quality and Quantity of Mankind ' War, Disease and Death This series becomes, as it progresses, increasingly socio biological and Prof Haldane's concluding essay on Biology and Statesmanship ' forms a logical ending

It would be easy to raise doubts and queries about many things in this book especially about Dr Baker's views implicit or explicit, on human genetics and its social implications, but it would not be fair to do so without bearing in mind the very serious limitations felt by the scientific writer, or speaker, when he has to address a lay audience on a technical subject It is only the rarest of expository geniuses who is able to combine absolute simplicity with complete accuracy Dr Baker is a little too afflicted with Dr de Kruif's 'baby language' technique, and Prof Haldane is just a little too objective and didactic for one to feel that either of them has yet reached the highest summit in this very difficult branch of scientific literature

In any event the proof of such a book is in the reading Presumably the authors intended to stimulate an interest in biology generally, and especially in the bearings of biology on the thought and activity of the ordinary citizen Whether or not they have succeeded must be a matter of experiment Our experience was that the effect on a lay person of reading these essays was to stimulate a flow of highly pertinent questions, by no means all easy to answer Indeed, many of them could only be answered by reference to further and somewhat more detailed or advanced books Since this is presumably exactly the effect the authors wished to achieve, it points to the conclusion that their little volume is to be regarded as very successful A L B

Gleichgewichtsfiguren Rotierender Flussigkeiten Von Prof Leon Lichtenstein Pp viii+175 (Berlin Julius Springer, 1933) 15 60 gold marks

THIS book may be regarded as a pendant to the author's "Foundations of Hydromechanics" and extends the same rigorous methods to the treatment of the problem of the equilibrium of rotating masses of liquid under their own gravitational attractions It summarises researches carried out by the author and his pupils during the past six years, mainly on existence problems of figures of equilibrium, of rotating masses of liquid in the neighbourhood of known figures of equilibrium, of homogeneous and also of heterogeneous masses of such liquid An integro-differential equation is constructed in each case and solutions are sought by the method of successive approximations, both for classical problems, such as those of Laplace and Liapounoff, and for new ones concerning one or more coaxial rings, Roche's satellites, liquid double stars with and without solid centres

The work constitutes a very valuable contribution to the literature of the subject and presumes a knowledge of calculus, potential theory and integral equations, but it is by no means easy reading, even for those possessing this knowledge, owing to the abstract nature of the reasoning employed It is well printed and commendably free from misprints, and will prove indispensable to all proposing to make a study of this branch of hydrodynamics

Yuman Tribes of the Gila River By Leslie Spier (The University of Chicago Publications in Anthropology Ethnological Series) Pp xviii + 433 + 15 plates (Chicago University of Chicago Press , London Cambridge University Press, 1933) 19s net

THIS study of the Yuman tribes of the Gila River, Arizona, is based upon field work sponsored by Yale University and the University of Chicago It is concerned primarily with the Maricopa, although the community since the beginning of the nineteenth century has been composite, the reason being that it has been Maricopa in speech and organisation since its formation Little of ancient custom remains The old outlook persists best in everyday behaviour, mannerisms, personal relations and speech Few are Christians The sib system, and its attendant naming habits is the most flourishing part of the old thought system Dr Spier by his investigation makes a valuable addition to the excellent series of studies of the Indians of California and the adjacent south west, for which the University of California has made itself responsible

The Physician's Art an Attempt to Expand John Locke's "Fragment De Arte Medica' By A G Gibson Pp vi + 237 (Oxford Clarendon Press , London Oxford University Press, 1933) 7s 6d net

DR A G GIBSON modestly describes his book as an attempt to expand John Locke's fragment De Arte Medica"—the opening of what was to be an essay on the philosophy of medicine, but which was left uncompleted Locke's words may have inspired the task, but Dr Gibson's views on the fundamentals of medical art are in no way an expansion of Locke's ideas , they are the reflections based not only on a professional life rich in experience in the arts of diagnosis, prognosis and treatment, but also on a real understanding of medical ideals and ethics Few doctors can be so perfect in their art that they have no lesson to learn from this book, and to the practitioner with most of his experience before him it will be of greater value than a stock of textbooks and scientific articles

The Spread of Tumours in the Human Body By Dr Rupert A Willis (Monographs of the Baker Institute of Medical Research, No 2) Pp x + 540 + 48 plates (London J and A Churchill, 1934) 25s

To the clinician, the secondary tumour is of significance only in its prognostic finality , for the pathologist, the importance of the primary relegates the metastatic growth to the background Yet much may be learnt about malignant tumours from a study of their paths in spreading and the nature of the tissues in which they prefer to form secondary growths Extensive study of records, critical consideration of theories, and the most painstaking and minute post mortem examinations, are the essentials in such research work , by adherence to them, Dr Willis has well surveyed a neglected corner of the field of morbid processes His book, if of limited interest to the physician and surgeon, is of primary importance to the pathologist, and an essential addition to the cancer research worker's library

Geographical Regions of France By Prof Emmanuel de Martonne Translated from the latest edition by H C Brentnall Pp xi + 224 (London William Heinemann, Ltd , 1933) 7s 6d

PROF DE MARTONNE'S work, which has had more than one edition in the original French, does not cover the whole of France but most of the important areas find a place and no essential feature of the framework of French geography seems to be omitted The book is the outcome of a course of lectures first delivered in the United States, and aims at relating the physical facts with the human interests The outstanding physical features are clearly explained and the book succeeds in giving a rational explanation of the contrasts in scenery exhibited by different parts of France It can be recommended for lucidity of exposition and simplicity of treatment

Einführung in die theoretische Physik By Prof Dr Clemens Schaefer In 3 Bänden Band 3, Teil 1 *Elektrodynamik und Optik* Pp viii + 918 (Berlin und Leipzig Walter de Gruyter und Co , 1932) 37 50 gold marks

THIS book contains a very complete account of electricity and magnetism in all their theoretical aspects, from the simple electrostatic field through crystal optics to the theory of relativity The treatment is clear, but it is quite definitely designed to appeal to the mathematician rather than to the experimental physicist The standard attains that of a postgraduate course, but the book lacks bibliographical details which one normally expects to find in a work of such importance

Struktur der Materie Vier Vortrage Von Prof P Debye Pp iv + 50 (Leipzig S Hirzel, 1933) 3 gold marks

IN this little booklet of fifty pages, Debye publishes four stimulating talks on the scattering of X rays by molecules, the electrical structure of matter, the molecular structure of liquids—including a fascinating account of the Brillouin derivation of the ratio of the velocity of sound to the velocity of light—and on the nature of solutions of electrolytes

Modern Ideas on Nuclear Constitution

By Dr. G. Gamow

WHEN the complexity of atomic nuclei was proved by the existence of spontaneous and artificial nuclear transformations, a very important question arose. From which of the elementary particles are the different nuclei built up? It seemed that this question could be simply answered as there were only two particles with pretensions to be elementary: the proton and the electron. The protons had to account for the main part of the nuclear mass and the electrons had to be introduced to reduce the positive charge to the observed value. For example, the nucleus of bismuth, with atomic weight 209 and atomic number 83, was considered to be constructed from 209 protons and $209-83=126$ electrons. It was also accepted as very probable that these elementary particles build up inside the nucleus certain complex units constructed from four protons and two electrons each (α particles). All this construction was in good agreement with the experimental evidence as electrons, protons and α particles were really observed being emitted in nuclear transformations.

The theory treating the nuclei as constructed of α particles, some protons and a certain number of electrons was worked out by Gamow. Although this theory gave some interesting results as to the general shape of the mass defect curve and the conditions of emission of α particles, it met with serious difficulties. It was very difficult to understand on the basis of the quantum theory of the electron how the electron can exist in a space so small as that limited by the nuclear radius. It was also not clear why the nuclear electrons, behaving in quite a strange and obscure way, do not affect the processes of emission of the heavy nuclear particles, protons and α particles.

About two years ago, it was shown by Chadwick that the experimental evidence forces us to recognise the existence of a new kind of particle, the so called neutron, also with claims to be held to play an important rôle in nuclear structure. The discovery of neutrons considerably simplified the difficulties about electrons in nuclei. One could now suppose that the nuclei were completely constructed of neutrons and protons (for example the nucleus of bismuth from 83 protons and $209-83=126$ neutrons) which probably sometimes unite to form an α particle (two neutrons and two protons). Thus the first of the above mentioned difficulties was, so to say, hidden inside the neutron, while the second one was actually removed.

On the basis of these new ideas, Heisenberg succeeded in building up a general theory of nuclear structure, accounting for the main features of nuclear stability. The basis of his theory is certain assumptions about the forces acting between neutrons and protons. It seems most rational to accept the view that the interaction between particles of the same kind is only due to electric charges (that is, no forces between two neutrons and the usual Coulomb repulsion between two protons), while between two different particles (neutron and proton) strong exchange forces come into play. These last forces are probably of the same kind as the forces between atoms playing the main rôle in quantum chemistry, and may be considered as due to the exchange of charge between the two particles in question.

This hypothesis explains at once why the number of nuclear neutrons for heavy elements is considerably greater than the number of protons (that is why the ratio of atomic weight to atomic number increases for heavier elements). In fact, if we neglect the Coulomb forces, the most stable state of the nucleus will correspond to equal numbers of neutrons and protons, as in this case all the possibilities of binding (by attracting exchange forces) between protons and neutrons are saturated. The presence of the Coulomb repulsion between protons will, however, shift the optimum in the direction of a smaller number of protons and the position of lowest potential energy of our system will correspond to the larger proportion of neutrons. As the importance of the Coulomb forces increases with the nuclear charge, one can understand that an equal number of neutrons and protons is possible only for the lightest elements (first ten elements of the periodic system) while for heavier ones the number of neutrons predominates (126 neutrons and only 83 protons in bismuth).

Accepting the simplest form for the law of variation of the exchange forces with distance —

$$I = a\, e^{br} \qquad (1)$$

and applying the quantum statistical method, Heisenberg calculated the behaviour of the nuclear model constructed from n_1 neutrons and n_2 protons. The result is that the particles are rather uniformly distributed inside a certain volume proportional to the total number of particles. This result fits very well with evidence otherwise obtained, that the density inside the nucleus is rather uniform and does not depend greatly on the atomic weight. The formula obtained for the total binding energy E of the nucleus as a function of n_1 and n_2 looks rather complicated and depends, of course, on the numerical values of the coefficients a and b in the expression (1) for the exchange force. Comparing this formula with experimental values of the mass defects of different nuclei, one can estimate the values of a and b. One finds thus $a=4.05\times10^{-5}$ erg, $b=1.25\times10^{12}$ cm^{-1}.

Very interesting consequences can also be obtained from Heisenberg's theory concerning the question of nuclear stability. It is easily understood that nuclei with a high positive electric charge must tend to emit positive particles From the point of view of the energy balance, the most favourable case for such emission is the emission of an α particle, as this removes from the nucleus a large amount of negative energy (the binding energy of the α particle itself), which is equivalent to the supply of an equal quantity of positive energy The condition for the possibility of α emission can be simply formulated if we consider it as a simultaneous subtraction of two neutrons and two protons from the nucleus in question The work necessary for such subtraction is evidently

$$\frac{\delta E}{\delta n_1}\,\Delta n_1 + \frac{\delta E}{\delta n_2}\,\Delta n_2$$

or as

$$\Delta n_1 = \Delta n_2 = -2$$

$$-2\left(\frac{\delta E}{\delta n_1} + \frac{\delta E}{\delta n_2}\right)$$

To make a spontaneous α disintegration possible, this quantity must be smaller than the above mentioned energy supply due to the binding energy $\Delta M_\alpha c^2$ of the α particle from neutrons and protons (The difference appears as the kinetic energy of the emitted particle) Thus the condition for α decay will be

$$-2\left(\frac{\delta E}{\delta n_1} + \frac{\delta E}{\delta n_2}\right) < \Delta M_\alpha c^2 \qquad (2)$$

In Fig 1 the ratio of the number of neutrons to the number of protons is plotted against the number of protons for all known isotopes The α stability curve as calculated from formula (2) is represented by a broken line (curve I) and one can see that it is situated too low One notices how ever that the theoretical curve apart from absolute values gives a good idea of the general form of this stability limit We may notice that the condition for the spontaneous emission of a proton

$$-\frac{\delta E}{\delta n_2} < 0 \qquad (2')$$

will give us a stability limit located very far to the right of the α stability curve, which means that spontaneous proton decay could only take place for very heavily charged nuclei (atomic number >200) On the other hand, the condition for the emission of a neutron

$$-\frac{\delta E}{\delta n_1} < 0 \qquad (2'')$$

is never fulfilled, which can easily be understood if we remember that neutrons, having no charge, are not at all repelled by nuclei

We must now turn our attention to the question of the emission of light particles From the point of view of the neutron-proton model of the nucleus, we must accept the view that the process of ordinary β emission is due to the transformation of a nuclear neutron into a proton with the liberation of negative charge in the form of an electron

$$n \longrightarrow p + \overset{-}{e}$$

On the other hand, the recent discovery of the Joliots of elements emitting positive electrons suggests the possibility of the reverse process

$$p \longrightarrow n + \overset{+}{e}$$

We can easily estimate the stability limits for such processes if we consider the emission of a nuclear electron as the subtraction from the nucleus of a neutron and simultaneous addition of a proton The condition for the positive energy balance of such a transformation will evidently be

$$-\frac{\delta E}{\delta n_1} + \frac{\delta E}{\delta n_2} < \Delta M_n\, c^2, \qquad (3)$$

where ΔM_n is the mass defect of a neutron as constructed from a proton and an electron In an exactly analogous way we obtain for the possibility of emission of a positive electron the condition

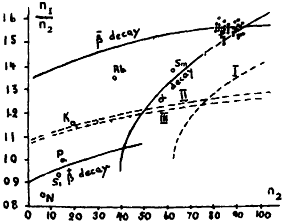

FIG 1 A map of all known nuclei Stable nuclei are indicated by full points unstable nuclei by small circles

$$-\frac{\delta E}{\delta n_2} + \frac{\delta E}{\delta n_1} < \Delta M_p\, c^2, \qquad (4)$$

where ΔM_p is the mass defect of a proton as constructed from a neutron and a positive electron From (3) and (4) we can conclude that the nucleus can be stable relative to electron emission only if

$$-\Delta M_p c^2 < -\frac{\delta E}{\delta n_1} + \frac{\delta E}{\delta n_2} < \Delta M_n c^2,$$

conditions which correspond in the stability diagram (Fig 1) to a very narrow band (curves II and III)*, in contradiction with the experimental evidence

The stability region can, however, be made much broader if we consider more closely the energy conditions connected with electronic emission from nuclei The point is that for a given total number of neutrons plus protons (that is, for given atomic weight) the nuclei are considerably more stable if the number of protons is even (even atomic number) The reason for this is that, with the increasing number of protons, each second one will lead to the formation of a new α particle, and consequently correspond to larger liberation of energy Thus if we plot the binding energy of isobaric nuclei against the atomic number (Fig 2) the points corresponding to even numbered elements will lie on a lower curve than those corresponding to the odd numbers As can be seen from the diagram, this will have the result that for a series of elements extending some way both to the left and to the right side of the minimum the emission of one electron (either negative or positive) will be energetically impossible In such cases only the simultaneous emission of two electrons can be considered but as can be estimated from general theoretical considerations such a double emission has extremely small probability The possibility is not excluded that the natural β activity of potassium and rubidium has its origin in such a double process which would easily explain their extremely long period of life

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* From the equations $n = p + \overset{-}{e} + \Delta M_n c^2$ and $p = n + \overset{+}{e} + \Delta M_p c^2$ we obtain $\Delta M_n c^2 - (-\Delta M_p c^2) = \Delta M_n c^2 + \Delta M_p c^2 = \overset{-}{e} + \overset{+}{e} = 2mc^2 = 1{\cdot}6 \times 10^{-6}$ erg This corresponds in Fig. 1 to a breadth of the stable region of about 0·016 units along the ordinate.

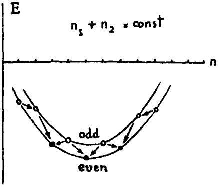

FIG 2 Mass defect curves for typical isobaric nuclei ● stable nuclei o unstable nuclei

According to these considerations we must push the limit of $\bar{\beta}$ stability upwards and the limit of $\overset{+}{\beta}$ stability downwards and thus get a considerably broader stability region It can be seen from Fig 1 that theoretical limiting curves give a good idea of the form of the actual stability limits, although just as in the case of α decay the curves go again too low It seems that both discrepancies have a common origin

In Fig 1 the points corresponding to unstable nuclei are shown by small circles One notices that in the region of the heavy elements, where α and β stability curves run rather close to one another (and possibly cross), the sequences of α-disintegrations followed by two β disintegrations are possible For the lighter elements only a few cases of spontaneous disintegration are at present known Samarium (most probably its lightest isotope) emits α particles of about 1 5 cm range and has an average life of about 10^{11} years The lightest isotopes of nitrogen silicon and phosphorus (N^{13}_{7}, S^{27}_{14}, P^{30}_{15}), unknown in Nature and produced artificially by the Joliots by α bombardment of boron, magnesium and aluminium, give $\overset{+}{\beta}$ particles with an energy of 1–2 million volts and possess life periods of several minutes

The $\bar{\beta}$ emission from potassium and rubidium must be explained either as a double electron emission from their heavier isotopes (K^{41}_{19} and Rb^{87}_{37}) or as due to some unknown isotopes of chlorine and bromine resulting from a very short range α emission of the above mentioned elements (probably from K^{41}_{19} and Rb^{87}_{37}) As these ranges in air as calculated theoretically from the value of the corresponding decay constants, are 0 24 cm and 0 63 cm respectively one can understand why the α particles have not yet been detected Thus we see that our general theoretical considerations fit rather nicely with the experimental evidence

We now turn our attention to the details of the processes of emission of α particles and electrons and the connexion of the disintegration energy with the average period of life The process of α emission can be explained on the basis of the ordinary wave equation of Schrodinger as the velocities of the emitted α particles are small compared with the velocity of the light It was shown by Gamow and independently by Gurney and Condon that the long life of α decaying bodies is due to the fact that the α particle leaving a nucleus must cross a very high potential barrier the transparency of which is extremely small and decreases very rapidly with the decrease of the energy liberated in the disintegration Theory leads us to the following formula for the decay constant λ as a function of the α particle velocity v

$$\lambda = \frac{4h}{mr_0^2} e^{-\frac{8\pi^2 e^2}{h}\frac{(Z-2)}{v} + \frac{16\pi e\sqrt{m}}{h}\sqrt{Z-2}\sqrt{r_0}} \quad (5)$$

where Z is the atomic number of the disintegrating element and r_0 the nuclear radius Accepting r_0 for radioactive elements to be of the order of magnitude $10^{\,13}$ cm one obtains very good agreement between the calculated and measured values of λ and can explain theoretically the empirical relation between lgλ and v found by Geiger and Nuttall

For complete agreement one must, however accept the view that the nuclear radius r_0 changes from one element to another in such way that the density of the nucleus remains constant ($r_0 \sim \sqrt[3]{A}$) Formula (5) permits us also to estimate one of the values λ or v if the other is measured Thus for example, the range of the α particles of radium C, estimated from this formula to be equal to 4 cm , is in good agreement with the value found later by Rutherford, and the period of life of the very short lived product radium C' given by this formula ($10^{\,6}$ sec) fits well with the recent measurements of Jacobsen

It is also interesting to notice that formula (5) may be successfully applied in the region of the lighter elements According to (5) the period of life of samarium as estimated from the velocity of its α particles must be about 10^{11} years in good agreement with the observed value

In the process of α decay, it may often happen that the nucleus of the product of disintegration is constructed in an excited state, which corresponds to the emission of α groups with slightly smaller energy (fine structure of α rays) The formula helps us to understand the relative intensities of such α groups and also permits us to draw certain important conclusions about the quantum numbers of the different excited nuclear levels On the other hand, it also explains the small number of so called long range α groups corresponding to the disintegration of excited nuclei

In contrast with the theory of α decay the understanding of the process of β disintegration presents serious difficulties First of all the electrons emitted in β decay possess a continuous distribution of energy, which seems to be in contradiction with the law of conservation of energy It was pointed out by Bohr that the law of conservation of energy need not necessarily hold for processes involving nuclear electrons for which the modern quantum theory is not applicable But, as was shown by Landau the rejection of the conservation law for energy will be connected with very serious difficulties in the general gravitational theory, according to which the mass present inside a certain closed surface is entirely defined by the gravitational field on this surface It was proposed by Pauli that one might retain the energy conservation law by the introduction of a new kind of particle called a 'neutrino These neutrinos, having no electric charge and possessing very small (or even vanishing) mass would be practically unobservable in all experiments and could easily take away the surplus energy of β-decay The existence of such particles is, however, at present rather doubtful

An attempt to construct a theory of β-disintegration on the basis of Dirac's relativistic wave equation, treating the emission of a nuclear electron in a similar way to the emission of light quanta by an atom, has recently been made by Fermi In this theory, one accepts the view that the transformation of a nuclear neutron into a proton is connected with the creation of an electron and a neutrino which, being born leave the nucleus, dividing between them the energy liberated in this transformation Accepting a definite value for the interaction energy giving rise to such transformations (of the order of magnitude of about 10^{14} erg) Fermi obtains reasonable values for the decay constants of β disintegrating elements and a good fit with the correlation curve between the decay constant and the maximum energy of the β particles as found by Sargent

An interesting consequence of this theory, which however, is much more general and will hold for every theory treating electron emission as the result of the transformation of a neutron into a proton, is a definite exclusion rule for β decay According to this rule β transformations in which the original nuclei and those produced possess different spins are not all permitted, and can only happen with a rather reduced probability (about a hundred times less often than transformations in which the spin does not change) This explains at once the two different curves obtained by Sargent as due to permitted and not permitted transformations It has been shown by Gamow that the application of the above mentioned exclusion rule for β decay to the analysis of radioactive families gives very good results and permits us to give definite spin values to normal and excited states of radioactive nuclei

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MM Osty's Investigations of Rudi Schneider

(From a Correspondent)

SCIENTIFIC men who have been anxious to form a fair and impartial opinion about the alleged physical phenomena of spiritualism have found it very difficult to do so There exist, indeed, records by a number of qualified scientific observers which if taken at their face value would establish the reality of these phenomena completely We may instance the names of Crookes, Zollner, Richet, A R Wallace, Varley, De Morgan, Lodge, W J Crawford and R J Tillyard These records have not produced general conviction, even in the view of those who have adequately studied them before undertaking to express an opinion, though it appears that those who have studied them have often been considerably impressed The accounts given are often insufficiently detailed to satisfy the student The possibilities of deception, of conjuring, of malobservation, and even of hypnotic suggestion acting on the observer and causing him to see the thing that is not have been difficult to estimate It is not often that the good faith of the experimenter has been questioned Indeed, to profess a belief in these things has been so manifestly contrary to the personal interests of a scientific worker, that it would be gratuitous to suggest that his adhesion is inspired by anything but the love of what seems to him to be the truth The circumstance that a poor light has usually been insisted upon is extremely suspicious, and justifies a very reserved attitude It is proper to remark, however, that in some recorded instances the light has been good

The object of this article is not to present a general or historical review of the subject, but to give a short account of some of the observations of Dr Eugène and M Marcel Osty with Rudi

Schneider described in a work entitled *Les Pouvoirs Inconnus de l Esprit sur la Matière* published in 1932 (Paris Félix Alcan) These observations should be of special interest to physicists because they were in large measure carried out by self recording instruments The graphs are reproduced for the student to examine and he can form his own opinion of them Mal observation and hypnotic suggestion as possible explanations are therefore largely excluded The possibility of deliberate deceit remains and will require to be carefully assessed But the scope for it seems to be much restricted as compared with previous investigations

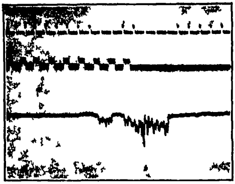

FIG 1 Top scale of seconds, advancing from left to right middle intermittent time signal bottom infra red intensities as ordinates and times as abscissæ

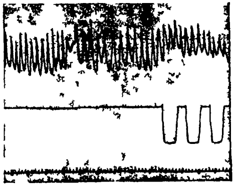

FIG 2 Bottom seconds and fifths advancing from right to left (note the change in middle signals synchronous with the other diagram top chest movements as ordinates and times as abscissæ

Attention was initially fixed on the alleged phenomenon of telekinesis or moving of objects by an unknown agency in the presence of the (controlled) medium It is generally known that a beam of light can be used to guard a treasure a warning bell being rung when a potential thief approaches it too near and intercepts the beam The method has been used when valuable objects are on public view It depends on an obvious application of a photoelectric cell combined with a thermionic valve actuating a relay Now it occurred to MM Osty that by using a beam of infra red light instead of visual light this method could be carried out in a dark séance room and that the object (flower handkerchief and the like) proposed for telekinesis could be guarded by the beam so that if the medium succeeded in escaping from the controller who was by way of holding him and attempted to seize the handkerchief in order to move it a bell would ring and give warning The controller would then be doubly on his guard and what was more important a flashlight photograph could be taken which would decisively reveal whether the medium or anyone else was doing anything suspicious It will probably be agreed on all hands that this was a well conceived plan of experiment not suggestive of undue credulity on the part of the experimenters

It was found that in fact the bell did ring on frequent occasions while the medium was or purported to be in trance The ringing was sometimes maintained for half a minute or even a minute Flashlight photographs were taken while the bell was ringing and they revealed the medium sitting in his usual hunched position with his head sunk forward his hands held and his knees between the knees of the controller Some of these photographs are reproduced in the volume one of the best is on p 45 There is nothing to be seen in the path of the infra red beam

It seems therefore that whatever it was that obstructed the beam it was not an ordinary solid obstacle Whatever obstruction it was that caused this effect seemed to fade away under the influence of ordinary light for lateral illumination of the path of the beam although it did not reveal anything had the effect of promptly stopping the ringing of the bell

Although the infra red beam was intercepted as if something was trying to reach the handkerchief or other object the latter was not often moved and the experimenters wisely decided to abandon this as a primary object of study and to concentrate attention on the unexplained phenomenon that was more easily obtained namely the obscuration of the infra red ray The bell was replaced by a galvanometer with a photographic recording drum adapted to give a continuous graph of the deflections The obscurations previously indicated by the bell were now photographed on the drum which gave a record of intensity and duration

After the work had been in progress for some time the ordinary galvanometer which had been in use was replaced by one of quick period (one tenth sec) with the view of examining in more detail how the obscuring action set in A very significant fact was then noticed When the ray was (partially) obscured it was seen that the galvanometer spot moved in sympathy with the loud and rapid breathing of the entranced medium The deflection was less (and the absorption therefore greater) during an inspiration *or* an expiration than at the times intermediate between the two It was clear therefore that the obscuring action was connected directly or indirectly with the medium's muscular processes This fact alone seems to rule out confederacy

When the above relations had been recognised, arrangements were made for automatically recording the motions of the medium's chest, at the same time as the infra red absorptions A scale of seconds was placed on each record, and by an obvious electrical method, synchronous signals were made on each so as to afford a time origin from which to measure the frequencies Sample records (Figs 1 and 2) are here reproduced from MM Osty s memoir The absorption lasts for 7 seconds, and oscillates with a frequency of 5 per second At the same time the breathing is at the rate of 2 5 per second These are the figures given by MM Osty They can be approximately verified from the half tone blocks in their publication, though the individual oscillations are not invariably well resolved in the reproduction

In attempting to estimate the work of MM Osty, we must consider in what directions there might be a chance of shaking their evidence Mere topics of prejudice should be avoided It has often been suggested that Rudi Schneider makes use of confederates, either secretly introduced, or openly present in the guise of sitters Will it help us to assume that he did so in this case ? The answer appears to be in the negative It is not apparent how a confederate could assist in producing the rhythmic obscuration in time with Rudi Schneider s breathing When it has been shown that an assistant, working without disguise can do this, the hypothesis of confederacy will require closer examination

Again it has often been argued that Rudi Schneider can get an arm free in spite of the apparent control This hypothesis has the same weakness as the previous one How can he use the (hypothetical) free arm to produce the effects ? No answer to these questions has so far been forthcoming

Lastly, is it possible that MM Osty were deceived, and that the records which they imagined they had obtained on their photographic drums were really prepared independently by Schneider or some confederate of his, and palmed off on MM Osty before development in substitution for their own records ? It must be remembered that the relation between Schneider's breathing and the infra red intensity was first noticed visually by the motion of the galvanometer spot, before it had been recorded photographically, so that this hypothesis also seems to fail

The value of the evidence of MM Osty, or of any other witnesses must depend on what view is taken of their good faith This in turn must depend on general reputation, on internal consistency and coherence of evidence, and on the possible motives for deception

It would be of the greatest importance for the work to be independently repeated in some other laboratory Unfortunately, Rudi Schneider's powers are apparently failing Some have considered this fact to be in itself suspicious It must be remembered however, that even at their best the phenomena were sporadic, with many blank sittings interspersed In any event, it is not clear why the trick, if trick it was, should not continue to be played as long as it is profitable On the alternative hypothesis it seems not particularly unlikely that exceptional natural powers of this kind might pass off with time, as do, for example, the powers of 'calculating boys'

Anyone who sees his way to a normal explanation for these effects would be doing a service to the cause of truth by setting up the apparatus and producing graphs similar to those published by MM Osty

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Obituary

Prof A N Meldrum

By the death of Prof Andrew Norman Meldrum on March 12 the activities of one of the best informed writers on historical matters relating to eighteenth and nineteenth century chemistry have come to a close The history of the greater movements in the progress of theoretical chemistry formed a favourite branch of study and research, and from an early period Prof Meldrum's attention was directed to the subject of the atomic theory, in connexion with which he published, so early as 1904, a thoughtful and elaborate monograph on "Avogadro and Dalton The Standing in Chemistry of their Hypotheses" This was followed by a series of papers "On the Development of the Atomic Theory", contributed to the Literary and Philosophical Society of Manchester in 1909–11, and by a pamphlet with the same title published in India in 1920 He was engaged during a number of years upon an intensive study of the works of Lavoisier and his contemporaries In this period he accumulated a large amount of material for the production of the successive lengthy papers that appeared between 1924 and 1934, dealing with Lavoisier s part in The Eighteenth Century Revolution in Science', with his historic Three Notes on Combustion 1772' and with his 'Early Work in Science 1763–1771 Besides these valuable papers, Meldrum contributed one of the three special commemorative addresses on Joseph Priestley that were read before the Chemical Society in April 1933, on the occasion of the bicentenary of that philosopher

In his published historical work, Meldrum appears as a close student as well as a keen and, at times, outspoken critic He was not willing to accept, without verification, the statements made by compilers, but was in the habit of making it a point to obtain first hand information from original sources In the case of his researches into Lavoisier's work, this usage involved the making of extensive inquiries in Paris, not only by correspondence but also by personal visitation, and in this way he ensured the authenticity of his own statements. After the publication, so recently as last January, of his concluding Lavoisier paper, he had begun a study of the life and work of Black and was actively engaged a few days before his unexpected death in a minute examination of the contemporary and subsequent literature relating to Black's discoveries.

Meldrum studied chemistry with Japp at Aberdeen and took his D.Sc. degree at the University there in 1904, his graduation thesis being the Avogadro Dalton monograph already mentioned. Afterwards he carried on research work in organic and in physical chemistry in collaboration with Japp, Perkin, jun., and others. In 1912 he was appointed to the professorship of chemistry in the Madhavlal Ranchhodal Science Institute, Ahmedabad, from which he was transferred later to the Royal Institute of Science, Bombay, both of these institutions being affiliated to the University of Bombay. From his post in the latter he retired in 1931 and resided thereafter in Edinburgh. He is survived by his widow and two daughters.

MR. R. LL. JONES LLEWELLYN

MR. RICHARD LLEWELLYN JONES LLEWELLYN, who died suddenly on April 19, had made a lifelong study of rheumatism and allied disorders, on which he was regarded as an eminent authority. The son of Surgeon Major Morris Jones of Aberystwyth, he assumed the name of Llewellyn in 1911 on his marriage to the Hon. Mrs. Crosse of Hulbertson, only child of the fourth Lord Headley.

Llewellyn had been president of the Balneological and Climatological Section of the Royal Society of Medicine, consulting physician to the National Hospital for Rheumatism at Bath, member of the conference on chronic arthritis convened by the Medical Research Council, chairman of the Medical Committee of the National Campaign for the Prevention and Relief of Heart Disease in Children, and vice president of the British Committee on Rheumatism, International Society of Medical Hydrology. He was also a member of the Board of Medicine, Welsh National School of Medicine, a fellow of the Royal Society of Medicine, of the Hunterian Society and of the Royal Meteorological Society.

In his researches into rheumatic diseases, Llewellyn was greatly helped by his brother, A. Bassett Jones.

Llewellyn was the author of several books and articles on rheumatism, arthritis, fibrositis and gout. At the time of his death he was engaged on a study of the relations of rheumatism to the absence of sunshine and the consequent failure of the skin to mobilise the chemical antecedents of the endocrines, a new view which has attracted considerable attention in the United States.

Llewellyn had been a member of the central appeals tribunal of the Ministry of Pensions, and was widely quoted as the author of "Malingering or the Simulation of Disease" (1917) and "Pensions and the Principles of their Evaluation" (1919). Llewellyn's style was picturesque and vivid; his conversation was arresting, original and spiced by shrewdness and humour.

MR. C. E. BORCHGREVINK

CARSTEN EGEBERG BORCHGREVINK, whose death at Oslo is announced, was born in that town, then Kristiania, in 1864. After an education in Norway and Saxony, he went to Australia in 1888 and spent some years in Queensland and New South Wales, first as a land surveyor and later as a teacher of modern languages and natural science.

When in 1894 Svend Foyn sent a ship to the Antarctic under the command of L. Kristensen and H. J. Bull to explore whaling possibilities, Borchgrevink signed on as an ordinary seaman, having failed to get accepted as a passenger. The ship reached lat. 74° S. in the Ross Sea and Borchgrevink in landing at Cape Adare was one of the first to set foot on the Antarctic continent. He also was the discoverer of plant life within the Antarctic Circle.

Returning to Europe, Borchgrevink tried in vain to equip a trading expedition to South Victoria Land to search for guano. In 1898, however, he induced Sir George Newnes to fit out the *Southern Cross* (formerly the Norwegian whaler *Pollux*) for a scientific expedition to the Ross Sea, the first since that of Sir James C. Ross in 1841. A wintering was made at Cape Adare where many valuable observations were made by L. Bernacchi, N. Hanson and others, and on the return of the ship in spring a voyage was made south to the Barrier face. Borchgrevink and W. Colbeck travelled over the Barrier to lat. 78° 50′ S., at that time a southern record.

In 1902 Borchgrevink investigated volcanic conditions in the West Indies on behalf of the National Geographic Society and in the later years of his life was curator of the Tömte Biological Station in Norway. He received the Patron's medal of the Royal Geographical Society in 1930, and a medal of the Royal Scottish Geographical Society in 1900. His chief publications were "First on the Antarctic Continent" (1901), "Das Festland am Sudpol" (1905) and "The Game of Norway" (1920–25). R. N. R. B.

WE regret to announce the following deaths:

Dr. Angel Gallardo, formerly Argentine Minister for Foreign Affairs, rector of the University of Buenos Aires since 1932, and president of the Academy of Sciences in Buenos Aires since 1927, aged sixty-six years.

Prof. C. W. Rolfe, emeritus professor of geology in the University of Illinois, an authority on the geology of Illinois, on April 6, aged eighty-three years.

News and Views

Prof A Fowler, F.R S

PROF A FOWLER, who, at the meeting of the Royal Astronomical Society on May 11, was presented by Dr Edwin Hubble with the Bruce Medal of the Astronomical Society of the Pacific, is the *doyen* of English speaking spectroscopists So long ago as 1885, he became attached to the Solar Physics Observatory at the Royal College of Science under the late Sir Norman Lockyer, with whom he remained until 1901 when, on Lockyer's retirement, he was given the charge of the astrophysical work of the College The intimate experience he acquired of the practical aspects of spectroscopy—a subject much more specialised then than now—was turned to good account, and his share with Lockyer in recognising the existence and importance of 'enhanced' lines (the basis of modern ionisation theory) was rapidly followed by the attribution of the *M* type stellar absorption bands to TiO and the 'comet tail' bands to low pressure CO, the identification of many solar spectrum lines with bands of water vapour and magnesium hydride, and other astronomical work of the first importance

THE sudden prominence given to spectroscopy in 1913 by Bohr s theory of the hydrogen atom offered an opportunity for the application of Prof Fowler's peculiar knowledge which he was not slow to accept The interpretation of enhanced lines as radiations from ionised atoms in the general case was mainly due to his work, and in a series of subsequent papers he provided some of the most fundamental observational data for the extraordinary development of atomic physics in recent times Under his influence and direction, a considerable school of spectroscopists has grown up, and many vital contributions to modern spectroscopy have been made by workers who received their original impetus from him Prof Fowler was in large measure responsible for the organisation of the International Astronomical Union, of which he was the first general secretary, holding office for six years Since 1923 he has been Yarrow research professor of the Royal Society—a position from which he retires at the end of the present session In addition to the Bruce Medal, his long list of honours is to be augmented this year by the award of the honorary Sc D and D Sc degrees of the Universities of Cambridge and Durham, respectively

Sir Richard Redmayne, K C B

AT the annual meeting of the Institution of Civil Engineers held on May 8, Sir Richard Redmayne was elected president in succession to Brigadier General Sir Henry Maybury This is, we believe, the first time a mining engineer has been chosen for this position of distinction, and Sir Richard's election is a mark of recognition of his important services to Great Britain and to the mining industry generally Born at Gateshead upon Tyne on July 22, 1865, Sir Richard, after being taught privately, passed through the Durham College of Science, Newcastle upon Tyne, and at eighteen years of age began practical work in the Hetton Collieries, Durham, of which he became the under manager In 1891–93 he was in South Africa, and then returning home, was for eight years resident manager of the Seaton Delaval Collieries, Northumberland In 1902, at the age of thirty seven years, he was appointed professor of mining in the University of Birmingham, and to him fell the task of planning the Department of Mining Six years later he was appointed H M Chief Inspector of Mines, and this important position he held throughout the War and until 1920 He had previously been employed by the Government on official inquiries and he afterwards served on many committees and Royal Commissions appointed to inquire into the use of electricity in mines the organisation of rescue work, safety lamps, explosions and spontaneous combustion, and the organisation of the coal industry Both when at Birmingham and since his retirement from the Home Office, he has practised as a consulting mining engineer He has served as president of the Institution of Mining and Metallurgy and is a vice president of the British Science Guild and president of both the Institution of Professional Civil Servants and the Association of Scientific Workers

New Foreign Members of the Linnean Society

PROF CAMILLE SAUVAGEAU of Bordeaux, and Prof G Otto Rosenberg, professor of botany in the University of Stockholm, were elected foreign members of the Linnean Society at the meeting on May 10 to fill the vacancies caused by the deaths of Prof K von Goebel and Dr Erwin Baur Prof Sauvageau first came into prominence in 1877 by his work on Tunisian cryptogams in collaboration with N Patouillard Since then he has been concerned almost exclusively with the study of the brown seaweeds He has worked out the life histories of a number of these algæ, choosing representatives of all the natural orders, and was the discoverer of the filamentous gametophyte in Laminariales He has also made elaborate taxonomic studies of the difficult genera *Fucus* and *Cystoseira* based on extended collecting experience Sets of his specimens illustrating the monographs have been distributed to the principal herbaria Prof Rosenberg is well known for his cytological studies, mainly devoted to development in flowering plants His thesis for his doctorate in 1897 was on the physiological cytology of *Drosera rotundifolia* This was followed ten years later by an account of the cytology of the hybrid *Drosera longifolia* × *rotundifolia*, in which he established the occurrence of chromosome segregation Other valuable researches have been on the embryology and pollen development of *Zostera* and the discovery of the phenomenon of apogamy in *Hieracium* and *Crepis* His broad outlook on cytology has enabled him to make several generalisations which have had considerable influence on problems of taxonomy and phylogeny

Mr R H Burne F R S

THE retirement of Mr R H Burne from the physiological curatorship of the Royal College of Surgeons Museum was marked by a complimentary dinner which was held in his honour at the Langham Hotel on May 10 Among those present were Sir Holburt Waring Sir Cuthbert Wallace Sir Arthur Keith Sir Arthur Smith Woodward Sir Peter Chalmers Mitchell Dr Tate Regan Sir Charles Ballance Prof E Barclay Smith Prof William Wright Sir Buckston Browne Prof E S Goodrich and Mr C Forster Cooper Mr Burne s contributions to zoological and anatomical literature have been outstanding in that they have been the result of painstaking dissection of the most intricate kind The physiological series of the Royal College of Surgeons contains innumerable examples of his masterful skill with the scalpel Many of these preparations illustrate discoveries which he has himself made but has never published His election to the fellowship of the Royal Society in 1927 was the recognition of his scientific work in the College Museum The complimentary dinner was in its turn a mark of appreciation by his friends of his modest and retiring personality

Television Committee

THE Postmaster General announced in the House of Commons on May 14 that the Television Committee is to be constituted as follows —Lord Selsdon (chairman) Sir John Cadman (vice chairman) Col A S Angwin Assistant Engineer in Chief G P O Mr Noel Ashbridge Chief Engineer B B C Mr O F Brown Department of Scientific and Industrial Research Vice Admiral Sir Charles Carpendale Controller B B C Mr F W Phillips Assistant Secretary G P O The secretary of the Committee is Mr J Varley Roberts Telegraph and Telephone Department G P O E C 1 and the terms of reference are To consider the development of television and to advise the Postmaster General on the relative merits of the several systems and on the conditions under which any public service of television should be provided

IT does not appear that any of the members of the Committee appointed by the Postmaster General have that practical knowledge of the scientific problems involved in television desirable for the consideration of the position and possible development of the subject It will be difficult therefore for the Committee to estimate with authority the value of the various systems which have been developed Even in regard to the commercial interests involved and the attempts made in other countries to popularise television the Committee will have mainly to depend upon the experience or knowledge of others Moreover since the relative merits of the systems of television to be examined may have to be decided on patent issues it is strange that no member of the Committee familiar with patent law and practice has been appointed It seems therefore that the Committee will have to base its report upon evidence given by the various television interests and we suggest that it would have been better if the Postmaster General had convened a conference of these interests and asked them to present an agreed report on the two main questions submitted to the Committee he has appointed He might thus have had the fullest technical information on television presented to him direct by the companies who command the services of all the television experts available As it is the Committee will have a difficult task in securing such information and assessing its value and whatever report is issued is likely to be challenged by companies concerned with the development of television

Plague of Blood sucking Flies in Yugoslavia

WE learn from the *Times* of May 12 that an insect plague is causing serious trouble in parts of Yugoslavia The insect in question is referred to as the golubatz fly which has recently appeared in parts of the country not previously troubled by the pest Several peasants and some 500 cattle and sheep have already perished A poisonous fluid injected by the fly has the effect of breaking down the red blood corpuscles so that when the bites become numerous death may supervene From the account given it is evident that the fly in question is a species of *Simulium* or buffalo gnat This genus comprises blood sucking flies which are troublesome pests in several parts of the world In regions bordering on the Danube the species *S columbaczense* which is most probably the fly involved in the present outbreak causes at times heavy mortality especially among horses as the result of its blood sucking propensities Its larvæ and pupæ live in streams and rivers while the adult flies sometimes occur in immense swarms In 1923 an invasion in Rumania is computed to have caused a loss to farmers of about £80 000 through the deaths of horses sheep pigs and other domestic animals Although human beings are also attacked and severely bitten fatal cases seem to occur but seldom In their efforts to control the plague the farmers used smoke screens and applied various repellent smears to their stock Much the same methods are being used in the present outbreak the peasants lighting bonfires in order to protect their stock the herds being kept indoors during the day and allowed to graze only between sunset and sunrise A feature of such outbreaks is that the flies may be carried long distances by the wind with the consequent invasion of areas where the farmers have no previous experience in applying control measures

Dust Clouds in the United States

A RARE meteorological phenomenon was experienced in New York on May 11 when a cloud of grey dust enveloped that city This cloud of dust is described as having reached the eastern seaboard of the United States early on that day and is said to have extended from New England down to Washington to have been denser in the Middle West and to have measured 1 500 miles by 900 miles in the horizontal and about three miles in the vertical

The damage and discomfort caused by the dust was evidently very great A synoptic weather chart for that day prepared in the Meteorological Office Air Ministry from wireless weather bulletins supports the suggestion made in the *Times* that the dust was carried by the wind from a region in Western Canada and the neighbouring States which is suffering from severe drought for a vigorous circulation of wind around a deep cyclonic depression is shown on the chart and this circulation is in about the expected position Aeroplanes are said to have encountered the dust cloud the pilots having estimated that it was travelling eastwards at speeds between 60 miles and 100 miles an hour The phenomenon can safely be compared in its origin with the dust storms of Egypt and Northern India a fall of red rain in London due to a circulation of wind round an anticyclone which brought down dust from the Sahara —investigated many years ago by Shaw and Lempfert —was essentially similar in character It appears to be one of the attendant evils of North American droughts that fine tilth can be removed from its proper place in the farmers fields and be deposited in distant States where its presence —even in agricultural country—is far from being immediately beneficial

Centenary of Liverpool Medical School

ON May 11 the University of Liverpool celebrated the centenary of the Liverpool Medical School In connexion with the celebrations a brief illustrated account of the School by Arthur A Gemmell has been issued (The Liverpool Medical School, 1834 1934 Hodder and Stoughton, Ltd London 1*s*) On the occasion of the conferment of honorary degrees to celebrate the foundation of the School an address was delivered by Prof John Hay professor of medicine in the University Until 1821 St Bartholomew s St Thomas s Guy s and the London Hospitals held the monopoly of medical teaching then the barrier against provincial teaching was broken down by the Society of Apothecaries in recognising the teaching of Dr Joseph Jordan in Manchester In 1824 the clinical teaching at the Manchester Infirmary School was recognised thus Manchester was the first provincial medical school in England Undoubtedly the efforts of the Manchester medical men were a stimulus to those in Liverpool Anatomy schools were developed first and finally a School of Medicine In 1837 the School was recognised by the London Society of Apothecaries the College of Surgeons and the University of London In 1884 it was incorporated with University College when the latter which was founded in 1881 was admitted into Victoria University In 1903 when the University of Liverpool was granted its charter the School became its Faculty of Medicine Among the distinguished occupants of the endowed chairs in the past have been Lodge, Campbell Brown Herdman, Gotch, Paterson, Boyce, Sherrington Benjamin Moore and Ronald Ross

ASSOCIATED with the School of Medicine at Liverpool is the School of Tropical Medicine, with seats on the Faculty of Medicine This School was founded in 1899 and has the distinction of being the first of its kind in the world In 1921 the School established a permanent laboratory at Freetown Sierra Leone and already has a brilliant record of studies in malaria yellow fever sleeping sickness blackwater fever vomiting fever as well as entomology helminthology and tropical sanitation At the celebrations the honorary degree of D Sc was conferred on Prof H R Dean professor of pathology in the University of Cambridge Sir Thomas Lewis physician University College Hospital Mrs May Mellanby investigator for the Medical Research Council Wilfred Trotter Sergeant Surgeon to the King and LL D on Prof William Blair Bell emeritus professor of obstetrics and gynaecology in the University Prof H Briggs emeritus professor of obstetrics and gynaecology in the University Herbert R Hurter Liverpool past president of the Liverpool Medical Institution W S Paget Tomlinson lately chairman of the Public Health Committee of Westmorland Prof Charles H Reilly emeritus professor of architecture in the University of Liverpool

Excavations at Ur 1933 34

DR C L WOOLLEY s lecture on The Year s Work at Ur given at the Royal Institution on May 11 afforded his audience a more favourable opportunity of appraising the results of this brief season s excavations than has been possible from the summary reports which have appeared in the Press The elucidation and study of the earlier phases of the occupation of the site have been carried down through pre flood strata to the bottom of the marsh before man appears on the scene The history of the ziggurat dating in its present form from 2300 B C of the attendant temples of the First Dynasty (3000 B C) and of the antecedent buildings which they replaced has been brought back to the very beginning of the plano convex period while beneath have been found still earlier periods of which the later must belong to the Jemdet Nasr age It was not possible at this point in the excavation area to carry the work to its logical conclusion by deeper digging, but Dr Woolley traced the course of excavations at the south eastern end of the Temenos area from the modern ground level right down to virgin soil through deposits of the age of Nebuchadnezzar the Kassite age (1400–1000 B C) the Sargonid period (2600 B C) and through a continuation of the Royal Cemeteries of the fourth millennium It was at this point in what was evidently a soldiers burial ground that the unique discovery of a female statue deposited as a funerary offering was made Below this were the archaic written tablets and seal impressions and at a still greater depth the graves extending over a considerable period of time which have proved so amazingly rich in stone vases of varied form and material In the mixed soil in which as well as in the sandy flood deposit were found the earlier graves yielding Jemdet Nasr ware there were abundant sherds of Al Ubaid ware thus completing a remarkable record which covers the complete range of Mesopotamian history from the middle of the first millennium B.C. to man's earliest occupation of the site, a period of not less than three millennia, possibly more.

Parallels of Habits and Beliefs

THE Frazer Lecture was delivered at the University of Oxford on May 10 by Prof. H. J. Rose, of the University of St. Andrews. The title of the lecture was "Concerning Parallels", and Prof. Rose discussed the legitimacy of the sort of parallels to classical religious phenomena which Frazer uses, leading up to a discussion of polygenetic versus distributionist views in anthropology. His general argument was that the use of parallels between the habits and beliefs of one people and another, while particularly conspicuous in the works of Frazer, is nothing new, being prominent in works published so early as the eighteenth century. It has generally involved recognition of the principle laid down by Bergier (1760) that "partout les hommes se ressemblent". Frequently there has gone with it a shallow conception of human evolution, tacitly assuming that the resemblance between different peoples at approximately the same stage of culture is so close as to amount to identity, and also that the stages of culture can be dated by merely placing first in time those which appear simplest and most brutish. This being the result of false reasoning and the neglect of elementary philosophic principles, has led to unsound results. In consequence, the attempts of the so-called historical school, of which Graebner, Pinard de la Boullaye and W. Schmidt are outstanding representatives, to establish objective criteria of dating and a strictly scientific method of handling the facts must be welcomed, whether the results they have so far achieved are acceptable or not. The criteria are, however, open to serious objection. Examples can easily be found of usages from peoples, wholly unconnected ethnologically, illustrating each other in a most welcome fashion, the common humanity of the minds of both being more important than any specific difference. The most fruitful activity of an anthropologist is rather psychological than historical or geographical, although these aspects should not be neglected; and to misunderstand the motive of an action may result in failure to place it even in its right historical context.

Royal Cornwall Polytechnic Society

THE hundredth annual report of the Royal Cornwall Polytechnic Society is of unusual interest. It contains among other matter accounts of the hundredth annual meeting held at Falmouth on February 21, 1933, and of the centenary summer meeting held on July 18–21. At the opening session of the latter the president, Viscount Clifden, occupied the chair and a series of addresses of congratulation was presented on behalf of the Royal Society, Royal Institution and other bodies. During the four days there were excursions and visits to works, and five addresses were delivered by well-known men of science. Sir Richard Gregory's address dealt with "Science Applied to Industry"; Sir John Cadman spoke on "Science, One and All", making special reference to the operations in the oil fields of Persia and Iraq; Sir Napier Shaw on "Unofficial Meteorology"; Dr. G. C. Simpson on "Modern Methods of Weather Forecasting", and Prof. S. J. Truscott on "Problems of Mining at Great Depths". These addresses are printed in full in the report, and that by Sir Napier Shaw is accompanied by an interesting series of photographs.

FREQUENT references were made at the meeting to some of the pioneers in Cornish industry, and one of the visits was to the Safety Fuse Works of Messrs. Bickford Smith and Co., Ltd., Tuckingmill. The invention of the safety fuse was due to William Bickford, who had been struck by the frequency of accidents in mines and the number of men in Cornwall totally or partially blinded through them. Appended to the report is an account of the work of the Falmouth Observatory, which has actively co-operated with the Meteorological Office since 1868. This was referred to in the address of congratulation from the Meteorological Committee signed by Sir Philip Sassoon, Under-Secretary of State for Air. Recently the old observatory tower, where the observations were made from 1868 until 1885, has had a commemoration tablet fixed to it.

Photography of Sound

"SOME Photographic Aspects of Sound Recording" was the subject of the Sir Henry Trueman Wood Memorial Lecture, which was given by Dr. C. E. Kenneth Mees, of the Eastman Kodak Company, at the Royal Society of Arts on May 16. Dr. Mees stated that the introduction of sound recording has influenced every section of the motion picture industry, from the nature of the original material selected for the presentation to the architectural design of the motion picture theatre itself. Two methods of sound recording are in general use, leading in one case to records in which the density of the photographic deposit varies, and, in the other, to records in which the area occupied by the photographic deposit varies. Reproduction depends on three qualities, loudness, frequency of pitch and wave form quality or timbre. The intensity range is limited primarily by the ground noise, which is chiefly due to physical defects in the films, such as scratches and dirt, although even in a perfectly clean film there is a very small amount of ground noise due to the granular structure of the silver deposit. By the use of special apparatus it is now possible to reduce ground noise considerably. The reproduction of high frequencies is dependent upon the resolving power of the photographic film. Special experimental apparatus has been designed to analyse the wave form and quality of the reproduction. "Improvements in the reproduction of sound by photographic means," Dr. Mees concluded, "will depend, in the future as in the past, on intensive scientific research in relation to sound, electricity, and photography."

Historical Physical Apparatus

SIR HENRY LYONS, formerly director of the Science Museum, delivered his presidential address to the

Institute of Physics on May 15, taking as his subject Physics and Science Museums" Sir Henry referred in particular to the work which the Board of the Institute has done through a special committee in locating pieces of physical apparatus of special historical importance, and ensuring so far as possible that they should be preserved from deterioration or possible loss This committee was appointed in 1925, and since then it has brought to light many objects which were little known to physicists generally and of which the historical importance was not always appreciated at its full value It was not until the middle of the eighteenth century that the first institution was established for the preservation of scientific instruments and technical apparatus, this was the museum of the Conservatoire des Arts et Métiers in Paris, which was founded in 1794 to include all kinds of machinery, models, tools, instruments, etc Little can now remain of the instruments and apparatus in use in earlier times, not only because in those times there was no institution where they could be deposited, but also because for the most part their historical importance was seldom realised Then probably more than now, an instrument once acquired was treasured for there were few of them, but it passed in time to a later generation which neither appreciated it nor understood its importance The same influence operates to day and there is much difficulty in securing for posterity the more important examples of apparatus which has played a part in the advance of science The address will be published in due course and copies will be obtainable from the Institute of Physics, 1, Lowther Gardens, Exhibition Road, London, S.W 7 (1*s* 1*d* including postage)

A New Nature Reserve in New Zealand

THE property of Brooklands, New Plymouth, New Zealand, was handed over by the trustees of the late Mr Newton King to the Borough of New Plymouth as a public reserve and officially opened by His Excellency the Governor General, Lord Bledisloe, on March 10 It adjoins the beautiful Pukekura Park, and forms a natural extension of it Together they comprise an area of more than 100 acres, forming a park second to none in the Dominion either in size or natural beauty In addition to the actual property of Brooklands, the Trustees presented five acres of native bush nearby, and, to give access to it and make the whole one large reserve, Mr T C List and Mr C A Wilkinson gave an area of seven and a half acres In his speech, Lord Bledisloe, after paying tribute to the late Mr King, pointed out some of the many natural advantages which the Dominion possesses, and said that it is unique in the number, variety and grandeur of its many beauty spots within a relatively small area and in its incomparable native bush, he prophesied that eventually New Zealand will find its tourist traffic the main source of its wealth While admiring the fine specimens of introduced trees, Lord Bledisloe gave a word of warning against the mixing of exotic trees with the native vegetation All those who have the preservation of the native vegetation of the Empire at heart will feel grateful for the interest which Lord Bledisloe has in their efforts, and for the help he is giving them

Safety in X ray work

IN a paper to the Institution of Electrical Engineers read on February 22, by Mr L G H Sarsfield, safety measures for workers with X ray plant were discussed He discussed the risks of fatal injury and the advantages and disadvantages of using signal lights The concluding portion of the paper dealt with the use of high voltage flexible cable and described some new types of cable which are coming into use Stress was laid on the need for definite instructions so as to avoid electrical dangers He suggested that the Institution should co operate with the British Institute of Radiology in framing rules In the discussion, Dr V E Pullin said that at Woolwich they had to legislate for uninstructed use, and so had to make the equipment absolutely safe Dr G W C Kaye, speaking as secretary of the International Protection Committee which will meet at Zurich next July, pointed out that international recommendations were framed as the result of the British Protection Committee's work, and these recommendations play a very important part in the design of equipment all over the world The League of Nations has issued a very comprehensive publication on the subject The British recommendations are now being revised and he hopes that the use of rubber floor mats and insulating shoes will have more consideration Dr B J Leggett said that too much talk of the need of protection made patients nervous In some cases, too much protection will prevent results being obtained In reply, Mr Sarsfield said that there is a real need for earthing the conductor at intervals along its length

Rothamsted Experimental Station

THE appeal for funds to purchase the Rothamsted fields has now secured in cash or good promises the £10,000 necessary to claim the munificent donations of £15,000 by Mr Robert McDougall and £5,000 by the Sir Halley Stewart Trust (see NATURE 133 442, March 24, 1934) The success of the purchase scheme is therefore assured, and the appeal is being kept open only a few days longer in order to enable the Committee to obtain the further amount needed to meet the agreed addition to the purchase price consequent on the ascertainment of the tithe charges, timber evaluation and other items Several organisations still have to make their final decisions, but it is confidently expected that the whole amount including these additional payments will be secured within the next few days, so that the Rothamsted Committee can enter into possession free of all financial obligation and free therefore to devote the whole of its resources to the important agricultural investigations in hand.

Annual Meeting of the British Medical Association

THE one hundred and second annual meeting of the British Medical Association will be held in Bournemouth during the week commencing July 23 under the presidency of Dr S Watson Smith and an interesting account by Mr Bernard Calkin of some of the geological and archæological features in the neighbourhood of Bournemouth is given in the *British Medical Journal* of May 5 p 814 Palæolithic implements bronze and early iron age relics and Roman remains have been found in several localities Eight of the seventeen known Hampshire earthenware beakers of the Beaker Folk (*circa* 1700 B C) were found at Bournemouth Early Iron Age sites in Bournemouth generally yield little beyond pottery fragments whereas in similar sites around Swanage animal bones and bone implements are frequent being preserved in the limestone district there but perishing in the sand and gravel of Bournemouth

Announcements

PROF W J DAKIN Challis professor of zoology in the University of Sydney has been elected president of the Linnean Society of New South Wales

LIEUT COL S P JAMES of the Ministry of Health has been awarded the Darling Memorial Medal and Prize of the Health Committee of the League of Nations for his work on malaria therapy

THE Abbé Henri Breuil has accepted the presidency of the Prehistoric Society of East Anglia for 1934 and will give an address at the meeting of the Society at the rooms of the Society of Antiquaries Burlington House London on May 23 at 2 30 on Engraved and Sculptural Stone Monuments in the British Isles of the Transition Period between the Stone and Bronze Ages an Essay of Chronology and Interpretation Non members of the Society wishing to be present should apply to the honorary secretary Mr G Maynard The Museum Ipswich

THE following awards have been made by the Royal Aeronautical Society Simms Gold Medal to Sir Gilbert Walker for his paper on cloud formation Taylor Gold Medal to Mr A Plesman (managing director of K L M) for his paper on the Amsterdam Batavia service Wakefield Gold Medal to Señor J de la Cierva for his work on the development of the autogiro Busk Memorial Prize to Mr A V Stephens for his paper on recent research in spinning Pilcher Memorial Prize to Mr W H Lewis for his paper on duralumin in aircraft construction

THE Council of the Institution of Electrical Engineers has made the following awards of premiums for papers read during the session 1933–34 or accepted for publication Institution premium to W Kidd and J L Carr Ayrton premium to B A G Churcher A J King and H Davies Fahie premium to T S Skillman John Hopkinson premium to Dr W G Thompson Kelvin premium to B L Goodlet Paris premium to Dr J L Miller and J E L Robinson Webber premium to G Shearing Overseas premium to S P Chakravarti extra premiums to Dr M A B Brazier Capt B S Cohen C W Marshall P D Morgan W G Radley and Dr S Whitehead H Rissik *Wireless Section Premiums* Duddell premium to F Walmsley Extra premiums to L H Bedford and O S Puckle F B Moullin and H D M Ellis A H Reeves *Meter and Instrument Section Premiums* Silvanus Thompson premium to Dr A H M Arnold extra premiums to J B Lees Dr E Mallett G F Shotter *Willans Premium* for a paper dealing with the utilisation or transformation of energy Mr D B Hoseason for his paper on — The Cooling of Electrical Machines

PROF G ELLIOT SMITH writes Acting on the advice of my physicians I have been persuaded that it is essential on grounds of health to resign the position of president of the recently established International Institute of Psychical Research I deeply regret the necessity for this action at the present moment when the Institute is about to embark upon certain interesting experiments the results of which should afford ample justification for its existence

THE Royal Society of Edinburgh commemorated the completion of its hundred and fiftieth year at a meeting of the Society held on May 7 1934 with Sir E A Sharpey Schafer president in the chair Prof D Arcy W Thompson delivered an address entitled Fifty Years Ago In the evening the Lord Provost Magistrates and Council of the City of Edinburgh gave a civic reception to the fellows in the Galleries of the Royal Scottish Academy which as the Royal Institution was for more than eighty years the home of the Society

APPLICATIONS are invited for the following appointments on or before the dates mentioned —A University demonstrator in physical chemistry at the University of Cambridge Mr H Thirkill Clare College (May 24) A lecturer in biology at the Diocesan Training College Fishponds Bristol—The Principal (May 26) A chief assistant engineer to the Rivers Mersey and Irwell Catchment Board—The Clerk to the Board County Offices Preston (May 26) A psychologist at the North West District Child Guidance Clinic—The Secretary 18 Belsize Crescent London N W 3 (May 30) Junior technical assistants (mechanical engineers and chemists) in the Supply Board Technical Establishment under the Director of Ordnance Factories—The Under Secretary of State (C 5) The War Office London S W 1 (May 30) A lecturer in geology at the Wigan and District Mining and Technical College—The Principal (May 31) A head of the Civil and Mechanical Engineering Department and a lecturer in electrical engineering at the Northampton Polytechnic Institute St John Street London, E C 1—The Principal (May 31) A principal of the Municipal Technical College Bolton—The Director of Education Education Offices Nelson Square, Bolton (May 31) A lecturer in geography and a lecturer in mathematics at Lincoln Training College—The Principal An assistant lecturer in zoology and a lecturer in economics at the University College of North Wales Bangor—The Registrar (June 2)

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return nor to correspond with the writers of rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Radioactivity Induced by Neutron Bombardment

EXPERIMENTS have been carried out to ascertain whether neutron bombardment can produce an induced radioactivity giving rise to unstable products which disintegrate with emission of β particles Preliminary results have been communicated in a letter to *La Ricerca Scientifica* 5 282 1934

The source of neutrons is a sealed glass tube containing radium emanation and beryllium powder The amount of radium emanation available varied in the different experiments from 30 to 630 millicuries We are much indebted to Prof G C Trabacchi Laboratorio Fisico della Sanità Pubblica for putting at our disposal such strong sources

The elements or in some cases compounds containing them were used in the form of small cylinders After irradiation with the source for a period which varied from a few minutes to several hours they were put around a Geiger counter with walls of thin aluminium foil (about 0 2 mm thickness) and the number of impulses per minute was registered

So far we have obtained an effect with the following elements

Phosphorus—Strong effect Half period about 3 hours The disintegration electrons could be photographed in the Wilson chamber Chemical separation of the active product showed that the unstable element formed under the bombardment is probably silicon

Iron—Period about 2 hours As the result of chemical separation of the active product this is probably manganese

Silicon—Very strong effect Period about 3 minutes Electrons photographed in the Wilson chamber

Aluminium—Strong effect Period about 12 minutes Electrons photographed in the Wilson chamber

Chlorine—Gives an effect with a period much longer than that of any element investigated at present

Vanadium—Period about 5 minutes

Copper—Effect rather small Period about 6 minutes

Arsenic—Period about two days

Silver—Strong effect Period about 2 minutes

Tellurium Period about 1 hour

Iodine—Intense effect Period about 30 minutes

Chromium—Intense effect Period about 6 minutes Electrons photographed in the Wilson chamber

Barium—Small effect Period about 2 minutes

Fluorine—Period about 10 seconds

The following elements have also given indication of an effect sodium magnesium titanium zirconium zinc strontium antimony, selenium and bromine Some elements give indication of having two or more periods which may be partly due to several isotopic constituents and partly to successive radioactive transformations The experiments are being continued in order to verify these results and to extend the research to other elements

The nuclear reaction which causes these phenomena may be different in different cases The chemical separation effected in the cases of iron and phosphorus seems to indicate that at least in these two cases the neutron is absorbed and a proton emitted The unstable product by the emission of a β particle returns to the original element

The chemical separations have been carried out by Dr O D Agostino Dr L Amaldi and Dr L Segrè have collaborated in the physical research

ENRICO FERMI

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April 10

Induced Radioactivity

CURIE and Joliot[1] and Ellis and Henderson[2] have observed that positrons were emitted when aluminium magnesium and boron were bombarded with high energy α particles They noted further that the positrons could be detected after the α particle bombardment had ceased It was therefore assumed that these electrons were produced by the radioactivity of the unstable nuclei resulting from the capture of the α particle and the expulsion of the neutron Danysz and Zwy[3] obtained similar results when they bombarded nitrogen with α particles

In order to account for the results obtained by bombarding certain ammonium salts in which hydrogen was in part replaced by diplogen with diplons Oliphant Harteck and Rutherford[4] assumed that a helium nucleus of mass 4 and charge 2 was formed by the union of two diplons which differed from the ordinary α particle in having a large excess energy and being in consequence unstable It is the purpose of this note to point out that in a similar manner the radioactivity of the light elements is due to the formation within their nuclei of an unstable proton of excess energy which disintegrates by emitting a positron It is suggested that the similarity of the disintegration phenomena observed is due to the radioactivity of this radioproton

It has been shown[5] that the emission of protons from neon magnesium silicon sulphur and argon can be explained by assuming that pairs of electrons are formed by the interaction of α particles and nuclei as suggested by a formula due to F Perrin[6] By assuming that the positron of the pair unites with a neutron to form a proton it was found possible to retain the hypothesis of stability of nuclei of mass 4*n* the feeble proton emission of the elements mentioned being due to the less abundant isotopes The mechanism was extended to the other proton-emitting elements and the conclusion arrived at in a previous paper[7] was confirmed namely that there are no free protons in nuclei these particles being combined with neutrons either as α particles or diplons This hypothesis will account for the induced radioactivity as follows

Consider for example the case of aluminium It is supposed that the proton emission is caused by the positron of the electron pair uniting with the free neutron the negative electron combining with the positron of the diplon to produce a quantum of γ radiation and leaving the stable nucleus $_{14}\mathrm{Si}^{30}$ When the energy of the α particle increases beyond a critical value it is supposed that the neutron is emitted before the high energy positron unites with it The radioproton is formed however as the positron unites with one of the two neutrons produced when the negative electron combines with the positron of the diplon This proton with excess energy disintegrates by emitting a positron From the reaction suggested it is expected that the positrons emitted will have definite energy and not a continuous range of energies as with the β rays of the normal radioactive elements The varying periods of disintegration are thought to be due to the varying nuclear fields in which the radioproton is formed

Further it is to be anticipated that similarly induced radioactivity will be observed with all elements which give rise to protons under α particle bombardment A full account of this hypothesis will be published shortly

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Curie and Joliot, *C R* 198 254, 1934
[2] Ellis and Henderson NATURE 133, 530 April 7 1934
[3] Wertenstein, NATURE, 133, 564 April 14 1934
[4] Oliphant Harteck and Rutherford NATURE 133 413 March 17 1934
[5] Walke *Phil. Mag* in print
[6] Perrin *C R* 197 1302 1934
Walke *Phil Mag* 17 729 1934

Accurate Electron Diffraction Measurements

IN order to compare the diffraction pattern of a substance of unknown characteristics with that of a known material Shishancow and Tartarinowa[1] suggest using two convex specimens mounted face to face the two patterns being recorded simultaneously

This method is obviously inapplicable to transmission diffraction and in the case of diffraction at grazing incidence the defects compared with the double shutter method[2] will be apparent Thus (1) owing to the specimen shadows the two sets of rings do not meet at a common pattern boundary (2) the rings are not described about a common centre (3) structural changes of a single specimen cannot be recorded under comparative conditions and (4) since only two relatively small segments of the beam cylinder are diffracted rings corresponding to large Bragg plane spacings are obscured (1) (2) and (4) militate directly against the attainment of accuracy (3) precludes the application of the method to a wide range of interesting phenomena[3] and (4) is conducive to error in assigning the correct crystal structure

The hollow cylindrical type of beam employed by Shishancow and Tartarinowa and previously described by de Laszlo and Cosslett[4] is a phenomenon well known in high speed cathode ray oscillography and is often observed with a badly pitted cathode The effect can be still further exaggerated by the use of a discharge tube of a design unsuitable for the production of the homogeneous solid pencil of cathode rays employed by us in our experiments

Other workers[5] in this field besides ourselves have used curved surfaces wires, fibres etc Where possible however the flat or approximately flat surface is generally preferred partly on account of the ease with which it can be prepared and systematically explored with the beam and also because the ratio of diffracted to undiffracted electrons is higher

We have previously shown that the occurrence of any voltage change during the recording of a double shutter pattern is automatically rendered self evident in the resulting photograph[2] The double shutter method permits of the attainment of a high order of accuracy comparable with that of X rays and can be employed in both transmission and grazing incidence diffraction its successful practice however like that of precision spectrography, calls for suitable equipment and instrumental technique

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May 7

NATURE 133, 686, May 5 1934
[2] Finch and Quarrell NATURE 131, 842 June 10 1933 *Proc Phys Soc*, 46 148 1934
[3] Finch, Quarrell and Roebuck, NATURE 133 23 Jan 6 1934
[4] NATURE 130 59 July 9 1932
[5] For example Yamaguti *Proc Phys Math Soc Japan* 14 57 1932 12, 203, 1930 Trendlenberg *Die Naturwissenschaften* 21 173 1933 and Eisenhut and Kaup *Z Electrochemie* 37 469 1931

Full Period Effect in Miller's Ether Drift Experiment

IN his memoir[1] on the ether drift experiment Dayton C Miller mentions that harmonic analysis of the curves of the displacements of the fringes obtained by a complete rotation of the interferometer puts in evidence in all cases the existence of a full period effect which accompanies the Michelson half period effect utilised in the elaboration of the results of the experiment The amplitude of the full period effect is of the same order of magnitude as the Michelson effect it is however proportional to the number of visible fringes in the field of view and—in the most favourable conditions for the experiment with six visible fringes—perceptibly less than the amplitude of the half period effect

According to Miller the full period effect is identified with that foreseen and calculated by Dr Hicks in a memoir of 1902[2] as a consequence of the small angular displacement μ of a few seconds of arc from its theoretical position that must be given to one of the mirrors to obtain the interference fringes

That this explanation of the full period effect cannot hold results at once if we consider that the Lorentz contraction ought to eliminate entirely any effect of the ether drift on the phenomenon of interference although it should influence only the half period effects It is then clear that the ether drift supposing it should appear is only able to produce half period effects that is displacements of the interference fringes that are reproduced identically every half turn of the interferometer This occurs of course whatever may be the effective adjustment given to the various parts of the instrument including the telescope

A direct demonstration may be derived from the results obtained by me[3] in 1925 in treating by a new method and in a complete manner the theory of the Michelson experiment following up the work of Righi[4] quoted by Miller in his memoir, which was interrupted by the death of the author My theory leads to the following formula for the displacement of the fringes when we take into consideration only the terms variable with the orientation of the interferometer given by the angle α

$$\Sigma = \frac{D\xi^2}{\lambda}\cos 2\alpha + \mu\frac{D^1\xi^2}{\lambda}\cos 2\alpha - \mu\frac{(D-D^1)\xi^2}{\lambda}\sin 2\alpha \quad (1)$$

where ξ is the velocity ratio λ the wave length *D* the effective length of the arm of the interferometer, D^1 the distance of the plane on which the observed inter ference fringes are localised Generally $D^1 = D$, that is the telescope is focused on the surface of the end mirror, in such cases the formula becomes

$$\Sigma = \frac{D\xi^2}{\lambda}\cos 2\alpha + \mu\frac{D\xi^2}{\lambda}\cos 2\alpha \qquad (2)$$

The first term here represents the Michelson effect, the others show that a supplementary effect of amplitude proportional to the angle μ or to the number of fringes visible in the field of view, may also be expected But such an effect is (*a*) of half period like the Michelson effect, (*b*) of amplitude μ ($\sim 2\times10^{-5}$) times less so that any possibility of an experimental verification is out of the question

The full period effect shown by interferometrical experiments *cannot be in any way justified by the classical ether drift theory* It is therefore the more important to know more thoroughly the characteristics of this effect which may be deduced from the rich observational material collected by Miller It may be either systematic perturbations introduced in the elaboration of the results of observation, or a phenomenon depending on another cause varying with the rotation of the interferometer perhaps the same that causes the difference between the results obtained by Miller and others who have experimented on the Michelson effect[4] and the unexplained anomalies that it represents[1]

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March 30

D C Miller *Rev Mod Phys* 5 203 1933
[2] W M Hicks *Phil Mag* (6), 3 9, 1902
[3] G Valle *Nuovo Cimento* (N S) 2 39 201 1925
[4] A Righi, *C R* 168 837 1919 170 497 1550 1920 171 22 1920
[5] G Joos *Phys Rev* 45 114 1934 D C Miller *ibid*

Photography of the Infra-Red Solar Spectrum to Wave-length 12,900 A

WITH the aid of the new Agfa infra red sensitive plates (maximum of sensitivity 10 600 A) I have succeeded in photographing the solar spectrum to 12,900 A in the first order of a 3 m grating (dispersion 5 A /mm time of exposure 10 hours) The blackening of the exposure obtained does not alter appreciably from 12 400 to 12 900 A (end of the plate used), so that it seems easily possible to extend the limit quite considerably

The plates so far obtained show the water vapour absorption band at 11,300 A well resolved into its fine structure lines and extending about 1000 A to both sides It exhibits the same sort of complexity as the shorter wave length bands photographed and analysed by Mecke and his co workers[1], but is much more intense

In addition, there is a very interesting *atmospheric oxygen band* between 12,500 A and 12,750 A also of course, with very well resolved fine structure This band has already been observed with ordinary infra red apparatus and low dispersion by Ellis and Kneser[2] in the infra red absorption spectrum of *liquid* oxygen together with other bands, and they have identified it with a weak maximum in Abbot's bolometer curves of the solar spectrum That this band is really due to the oxygen molecule and represents the 'forbidden' transition from the ground level $^3\Sigma_g^-$ to the low $^1\Delta$ level first predicted by Mulliken[3] is rigorously proved by a preliminary fine structure analysis The observed structure shows that the selection rule $\Delta J = 0 \pm 1$ still holds for $^1\Delta - {}^3\Sigma$, but besides $\Delta K = 0, \pm 1$ (P, Q and R branches) transitions with $\Delta K = \pm 2$ occur with about equal intensity (S form and O form branches) The band on the whole is very much weaker than the ordinary atmospheric oxygen A band at 7600 A in agreement with the expectation that a $^1\Delta - {}^3\Sigma$ transition is more strongly forbidden than $^1\Sigma - {}^3\Sigma$ Preliminary constants for the $^1\Delta$ level are $\nu_e = 7881\ 6$ cm^{-1}, $B_e = 1\ 415$ cm^{-1}, $r_e = 1\ 220$ A A value for the vibrational frequency cannot be given because the 1–0 band observed by Ellis and Kneser at 10 600 A in liquid oxygen does not occur in the solar spectrum

A full account of this work will appear elsewhere

In conclusion it is a pleasure to acknowledge the kindness with which the firm of Agfa placed their remarkable new plates at our disposal

G HERZBERG

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Technische Hochschule Darmstadt
April 10

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[1] R Mecke and W Baumann Das ultrarote Sonnenspektrum von 7500–10,000 A Leipzig 1933
[2] J W Ellis and H O Kneser, *Z Phys* 86 583 1933
[3] R S Mulliken *Phys Rev* 32 880 1928

Velocity of Light

M E J GHEURY DE BRAY has directed attention to an apparent decrease in the velocity of light[1] I have recently tried to explain this on the basis of the theory of the expanding universe If the speed of light is a true constant independent of any variation in our unit of length then a doubling of the radius of the universe should cause the *measured* velocity of light to diminish by half If the radius of the universe doubles every K years then the velocity of light will be proportional to $(\frac{1}{2})^{t}$ where K is the unit of time Thus the logarithm of the measured velocity of light must be a linear function of the time I determined the two constants of such a function from de Bray's data and found that it represented the observations in a satisfactory manner I then solved this equation for the length of time it would take the velocity to diminish by half The time is of the order of 60 000 years which is considerably shorter than the value derived from a study of the recession of the external galaxies[2] Consequently this observed variation cannot be explained by the expanding universe theory unless we assume that the rate of expansion is much more rapid in the vicinity of the earth than it is at the distance of the spirals

It is also possible that the variation is not a continuous decrease but is a periodic function of the time A rough graphical analysis shows that the observations are well represented by

$$V = 299\ 885 + 115 \sin 2\pi/40\ (t - 1901)$$

The largest deviation is 21 km /sec and the others are all under 10 km /sec It is possible that these residuals could be improved by further adjustment of the constants

Unfortunately, the only evidence for a periodic variation is the observations in 1879 5, 1882 7 and 1882 8 These observations were made over short base lines, and are presumably not as accurate as those made over longer base lines If we reject them, as we may feel justified in doing, then the variation is a continuous decrease with the time. If we keep them, the variation is periodic. Either hypothesis beautifully represents the observations which are used. The unfortunate lack of observations in the periods 1883–1902 and 1902–1924 makes it impossible at present to decide between the two hypotheses. However, by 1941 the velocity will be 299 885 km./sec. if the variation is periodic, or 299 735 km./sec. if the variation is a linear decrease with the time. It is to be hoped that those who have been performing velocity experiments will continue their work until this matter is settled.

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April 14.

NATURE, 120, 602, Oct. 22, 1927; 133, 464, Mar. 24, 1934. *Ast. Nach.*, No. 5520, 1927. *Ciel et Terre*, various papers, 1927–1931.

[2] The Expanding Universe, page 14.

Static Charge on a Galvo-Millivoltmeter

A SOMEWHAT curious state of affairs has recently been brought to light in this Laboratory in connexion with a Unipivot galvo millivoltmeter. The needle of this instrument, which is used in the determination of *p*H values by the electrometer valve–glass electrode method, was found to behave erratically in respect of reproducing its maximum position. On closer examination it was found that, particularly in the case of certain individual operators, rubbing the glass cover of the instrument with the finger or even strong finger pressure produced deflection of the needle sometimes sufficiently violent to lift it from its suspension. Return of the needle, though not exactly to its former position, could usually be effected by tapping the glass.

Neither distortion of the case, nor capacity effects were present, and breathing on the glass cover was sufficient to restore a normal zero or maximum.

Although the case, in common with other vital parts in the electrical system, is normally earthed, it seems clear that a static charge on the glass is responsible for the phenomenon, and the necessity for bearing this possibility in mind when cleaning or removing dust becomes necessary with such an instrument is obvious.

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Purification of Plant Viruses

THE following is a practical method of preparing a purified suspension of any of the X group of plant viruses from the extracted juice of the diseased plant.

Starting with volume *V* of extracted juice —

(*a*) *V* is cooled to 0° C. and diluted to 15 *V* with water at 0° C. Carbon dioxide gas is passed through the mixture at 0° C. for 30 minutes. This mixture is then centrifuged rapidly for as short a time as will give a clear straw-coloured supernatant, for example, 15 minutes at 3 000 r.p.m. The precipitate, which contains about one third of the original solids, is discarded.

(*b*) The supernatant is diluted to 200 *V* with water at 35° C. Carbon dioxide gas is passed through the mixture at 35° C. for 15 minutes. This mixture is then centrifuged for a considerable time, for example, 1 hour at 2 000 r.p.m. The supernatant is discarded.

(*c*) The precipitate is suspended in *V* c.c. distilled water at room temperature and centrifuged for a short time, for example, 15 minutes at 3 000 r.p.m. The precipitate is discarded. The supernatant is faintly opalescent but colourless. It contains most of the virus and practically no protein.

In (*a*) the flask is immersed in a freezing mixture. The best results are obtained when only a small amount of ice is formed in the solution and the temperature during the spinning does not go above 15° C.

In (*b*) cautious use of a micro burner will keep the temperature within half a degree of the optimum.

The long spinning of the large volume in (*b*) is the greatest fault of this method. The length of the spinning required to bring down a precipitate can be shortened to less than half an hour if higher speeds are used, also by adding a trace of aluminium sulphate or leaving the mixture in the cold overnight.

The method is a modification of one used by Warburg and Christian (1932)[1] to purify a water-soluble ferment. (The application of the method to virus studies was suggested by Prof. D. Keilin, to whom grateful acknowledgment is due.) The temperatures and dilutions given here have been determined after careful variation of all the constants. With virus X from infected tobacco plants, a final suspension can be produced which will infect 3 out of 5 *Nicotiana glutinosa* plants at a dilution of 1/50 000 as compared with 4 out of 5 with crude sap at the same dilution.

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April 16.

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[1] *Biochem. Z.*, 254, 440; 1932.

Inheritance of Habits

Do thought habits produce a physical change in the organism? I once asked a friend of mine who is a great experimentalist. He replied: "I don't know." "Does any habit produce a physical change?" He again replied: "I don't know." "Could he suggest any experiment to ascertain this point?" Once again he replied in the negative. I could see the discipline of science had produced a habit in him which the stimulus of my suggestion was not strong enough to overcome.

Were it not the case, then why do people find it difficult to change from one habit to another? It is not only difficult, but it is often accompanied by a feeling of positive pain. A transformation from one thing to another implies loss or gain of energy, and this energy must be summoned and given a direction before a change could be produced from one habit to another. Consider, for example, the difficulty many people are now experiencing in assuming the habit of a 24-hour clock.

Can habits be inherited? For anything to be inherited, the reproductive cells must be affected in a particular way. Experiments have been performed to settle this question. Mice have been trained to thread a maze of a particular configuration, and the offspring of such trained mice have been able to thread the same maze with the least difficulty and in the shortest time. This seems to indicate that acquired habits can be inherited. Recently experiments have been undertaken in Prof. E. W. MacBride's laboratory to see if the parthenogenetic stick insect of Ceylon could inherit the habit of eating plant *B* (which it can eat but does not usually do) instead of *A* which is its usual food plant. An account of this was published in NATURE of April 21 (p. 598). The result seems to show that such a preference can be *transmitted to the offspring*.

The difference between the maze threading experiment and that of compelling the acquisition of a new food plant is that in the former case no foreign matter is introduced into the body of the organism while *in* the latter case a different kind of food is introduced. In the former the habit is not accompanied by an obvious physical change in the organism while in the latter it is nothing but the acceptance on the part of the organism of a physical fact.

Whatever *may* be the *conclusions* drawn *from* these experiments, to determine whether a habit is inherited or not information on the following points is first necessary (1) Does habit produce a physical change (2) if so how can it be measured (3) in what *way is this change registered in the reproductive cells?*

It seems to me that the experiments so far undertaken have the same hit and miss character as those of the animal breeders before Mendel's time. For example it could not be predicted that a particular egg taken out of the lot produced by those insects that easily accepted the second food plant would result in an insect which showed a definite predilection for this alternative host plant.

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Mimicry in Insects

PROF. T. D. A. COCKERELL points out[1] that parallelism and convergence are so frequent that they indicate deeply seated tendencies which find expression without any reference to immediate utility and that if mimicry is promoted by natural selection these resemblances are the raw material on which it works.

May I remark that the last words quoted are *misleading in their suggestion that* convergence *may play a large part in the causation of all the cases* of resemblance of one animal to another which are unfortunately classed together in the common usage of the term mimicry.

It is indeed possible that convergence (or arrested divergence) has played a part in the production of synaposematic resemblance such as Prof. Cockerell mentions in the case of wasps, although even in such cases there is no relation between the degree of resemblance and the degree of consanguinity. The similarity between species of the well known Burnet moths in England might, with justice be claimed as a good example. But this explanation, so simple and plausible, is of much too limited applicability to deal with the phenomena of mimicry. It cannot explain such examples of true Batesian mimicry as the pseudaposematic resemblance of a caterpillar to a snake which deceived Bates himself. Nor can it possibly apply to the analogous and equally deceptive procryptic resemblance of a caterpillar to a stick, or a moth to a bird dropping.

I find it difficult to understand how parallel development can have played any part in the production of a similar appearance in insects of different degrees of relationship by entirely different means, a phenomenon in mimicry too often left out of account in discussions. Upholders of the Darwinian explanation of mimicry are still awaiting an alternative which will embrace the above mentioned and many other phenomena which fall into line.

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[1] NATURE 133, 329, Mar. 3, 1934.

Pseudopodial Movements of Foraminifera

WORK of recent years has done much to elucidate the protoplasmic changes accompanying amoeboid movement. The endoplasmic streaming which is the most striking feature in the pseudopodium of an amoeba is not however present in most other rhizopods in which locomotion by creeping is less well developed and it seems that the time is ripe for a careful re-examination of the different types of pseudopodia.

In the Foraminifera the pseudopodia are long fine protoplasmic threads containing granules the size of which varies with the species and which are in rapid longitudinal movement. Commonly both centrifugally and centripetally moving granules are present simultaneously in the same thread often passing one another even though the thread may be less than a micron in diameter. Sometimes also a pseudopodium may be increasing in length at a time when the predominant movement of the granules is centripetal indicating a movement of the clear ground protoplasm independent of that of the granules. The granules are usually (perhaps always) near the surface of the pseudopodium and it is commonly supposed that the clear axial part of the protoplasm is of a more solid nature thus conferring stability on the fluid thread which otherwise would be expected to break up into drops owing to the fact that its length is often some hundred or more times its diameter.

Though it is at present impossible to give a clear account of the exact location of these various moving streams or of the nature of the motive force producing them or of the conditions of stability of the fluid pseudopodia the following preliminary observations have some bearing on these questions.

(1) In all the species examined by me the pseudopodia are enclosed by a relatively tough moving skin which can be demonstrated by various methods. Crawling ciliates may pluck the pseudopodium pulling and stretching it considerably without adhering to it. Small flagellates may even come to rest against a pseudopodium, be carried along passively for a considerable distance and then swim away without any sign of sticking. In transporting food, on the other hand, the pseudopodia show themselves to be very sticky. This may be due as Verworn[2] believed to active secretion of a sticky substance, but seems to be more probably due simply to penetration of the 'skin' by the captured object causing it to come into contact with the viscous internal fluid.

(2) The mean velocity of the granules in different pseudopodia of an individual at any instant is fairly

uniform and quite independent of the diameters of the pseudopodia Hence their movement cannot be compared to the flow of a viscous liquid in a tube

(3) The flow is not influenced in any way by contact with a solid substratum, a fact which is quite inconsistent with any simple interpretation based on surface tension differences Normal streaming of granules takes place even in pseudopodia having no free tip (that is, running from one part of the periphery of an animal to another part), and so can have nothing to do with conditions at the tip or with any kind of physiological gradient between the tip and the base There is likewise no evidence of any reversible sol gel process or of any contracting tube of plasma gel

(4) Injurious stimuli (chemical or thermal) cause the pseudopodia to break into liquid droplets, or, less commonly, into short rods These two reactions might appear to represent the effects of increased and decreased fluidity respectively but this explanation does not fit in with the known effects of the stimuli in question on other kinds of protoplasm In fact sometimes a single stimulus produces both of the reactions simultaneously in different parts of a single individual If the stability of the threads depends upon the presence of a relatively solid axial structure it seems strange that reagents which normally increase the viscosity of protoplasm should cause the threads to break into drops Cyanide causes a cessation of movement without any immediate disintegration so stability of the threads does not depend upon movement as suggested by Lepeschkin[2]

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[1] Quoted by Jensen *Arch ges Physiol* 87 1901
[2] *Biologia generalis* 1 1925

A Rapid Test for Pregnancy on *Xenopus lævis*

IN a recent communication Bellerby (1933)[1] has shown that injection of acid or alkaline extracts of bovine anterior lobe of the pituitary gland into female South African clawed toads (*Xenopus lævis*) produces extrusion of ova through the cloaca within 18 hours

The well known Zondek Ascheim test or its modification by Friedman, using the rabbit, is based on the occurrence in the urine of pregnancy of an anterior pituitary like gonado kinetic hormone

These considerations led us to investigate the possibilities of *Xenopus lævis* as a test animal for pregnancy The urine is detoxicated, precipitated and concentrated according to the method of Zondek (1930)[2] The aqueous extract is injected into each of six female South African clawed toads Twelve to eighteen hours later at room temperature, that is, about 18° C, a positive reaction is indicated by either (*a*) extrusion of macroscopic ova through the cloaca, or (*b*) post mortem examination of the animal (in the absence of ovulation), when one ovum or more is seen in either or both of the oviducts If (*a*) occurs in any one animal, post mortem examination of the remaining animals is unnecessary A negative test is repeated on a further six animals

At higher temperatures, for example, about 27° C, the reaction is speeded up considerably and ovulation has already occurred so soon as 5–6 hours after injection

In a series of 97 cases investigated by this method to date, 52 correct positive and 45 correct negative findings have been recorded

Xenopus is a suitable test animal as it does not ovulate spontaneously under laboratory conditions As a matter of fact, in about 250 toads fresh from the ponds examined during the breeding season, no ova were detected in the oviducts (Zwarenstein and Shapiro 1933)[3] However, during the breeding season (July to September in South Africa) as an additional precaution it is necessary that the test animals from the ponds should be isolated under laboratory conditions for at least one week and controls killed and examined

We have observed that if the toads have been maintained under laboratory conditions for longer than three to four weeks, they appear to undergo a desensitisation to the urinary prolan, when incorrect negatives may be obtained The laboratory age of the test animals should therefore not exceed three to four weeks

The advantages of the test are as follows —

1 The test animal is cheap easily available and inexpensive to maintain

2 It is not necessary in the majority of cases to kill the test animal as it is with rats mice and rabbits

3 The extremely short time taken for the test—16 18 hours at room temperature (18°–20° C) A technique for further shortening the post injection latent interval is being investigated

4 The simplicity of the end reaction—extrusion of easily visible ova through the cloaca or their presence in the ducts In Amphibia extrusion of the ova is a sufficiently obvious and unequivocal phenomenon

5 Small volumes of aqueous extract may be injected into the test animal in a single dose repeated and divided doses being unnecessary

Although extrusion of ova does not occur in *Rana* after injection of anterior pituitary extract[4] a reaction is obtained in the oviducts and this indicates the possibility of using *Rana* also as a test animal

In collaboration with Dr A I Goldberg the test is being applied in the investigation of cases of endocrine anomalies

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April 12

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[1] Bellerby C W, *Biochem J* 27 615 1933
[2] Zondek B *Klin Wochenschr* 9 964 1930
[3] Zwarenstein H and Shapiro H A *J Exp Biol* 10 372 1933
[4] Bellerby C W private communication (1933)

A New Guinea Fish Poison

UNDER this heading Prof A K Macbeth refers in NATURE of April 28, p 649, to a probable Derris species the native name of which he gives as *Tua* or *Tuva* Without any philological gymnastics, this name is evidently a variant on the Malay name *Tuba*, applied to various Derris species In Polynesia I believe that the word is also softened to *Duva* or *Tuva*

Further information on the use of *Tuba* will be found in the late J D Gimlette's "Malay Poisons and Charm Cures" (third ed, 1929, p 240 *et seq*)

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Research Items

Egyptian Head-rests Among recent acquisitions noted in the *British Museum Quarterly* vol 8 pt 3 is a small collection of Egyptian objects of exceptional interest which are described by Mr S R K Glanville Among these are two head rests of which one of limestone is reported to have come from Dair Mawas on the other side of the river from Al Amarnah It is remarkable both for its form and its decoration It is adapted from the type with octagonal fluted column found commonly in the Eighteenth Dynasty and more rarely in the Fourteenth The space between the horns of the rest proper and the base has been only partially cut away so as to leave a panel of stone on either side of the shaft This minimised the risk of breaking off the tips of the rest These panels have been decorated in low relief with four figures one on each side of the shaft On what is probably the front of the head rest two figures of Bes face inward to the support The figure on the right brandishes a serpent in his left hand and carries a spear in the other Two more snakes are held beneath his teeth He wears the lotus flower often shown on the head of Bes and Taurt in the Eighteenth Dynasty A hieroglyphic inscription down the centre reads Good Sleeping in the West the Land of Righteousness by the Royal Scribe Qenherkhepeshef justified On the back of the rest a griffin on the left with lotus flower head dress faces a lioness eating a snake Both rest their feet on conical supports and are armed with knives Two more inscriptions run down the edges of the panels of which one survives in a mutilated state The four figures are reminiscent of those on carved ivory wands of the Seventh to Eighteenth Dynasties the use of which is still debated If the head rest is to be dated to the Eighteenth to Nineteenth Dynasty this is the earliest representation of Bes with a spear giving him a warlike character The magical character of the figures and the inscriptions indicate that the head rest was part of the tomb furniture and not for ordinary use

Anthropometric Technique A critical examination of the methods of anthropometric measurement on the living has been made by Dr C B Davenport Dr Morris Steggerda and Dr William Drager (*Proc Amer Acad Arts and Sci* 69 6) Errors in anthropometry are both extrinsic and intrinsic Among extrinsic errors while the apparatus used may be regarded as standardised the determination of particular landmarks is a frequent cause of error A matter insufficiently investigated as yet is the error due to differences in posture of the subject and the fluctuations due to his or her psychological or physiological state It is known that there are considerable differences according to the time of day at which the measurements are made Within limits anthropometry is a form of psychometry Variation due to differences in pressure on the skin in taking measurements has not been sufficiently considered With the view of testing the effect of these sources of error forty nine measurements were made repeatedly under certain controls It was found *inter alia* that stature and sitting height were significantly greater in the morning than in the evening A woman's indoor clothing does not appreciably affect the significance of the measurement though it may obscure the location of the point measured The diameters of the head are easily measured with a probable variation in repeated measurements of less than 1 mm Certain dimensions have a high variability with a probable error of single measurements of 5 mm or more These are waist girth chest girth projective arm measurements from the floor and trochanter breadth It was found that the subject measured was significantly larger on her left side than her right As an intrinsic error it was found that in the personal equation the percentage inaccuracy varies greatly being low in large dimensions The inaccuracy is partly inherent but practice leads to increased precision

A New Trout from California. Mr John Otterburn Snyder has recently described a new species of cut throat trout *Salmo seleniris* (*Proc Californian Acad Sci* Fourth Series 20 No 11 1933) This has been found in certain headwaters of Silver King Creek a tributary of East Carson River which is part of the Lahontan drainage area The habitat is restricted by an impassable fall to the creeks of Fish Valley in the high Sierra of California The author states that it is an isolated variant of *S henshawi* differing markedly in the absence of spots from the body the retention of parr marks to maturity and the relatively smaller and more numerous scales The differentiation of this form from the more generally distributed parent species is directly parallel with that of the golden trouts west of the Sierra as they differ from the rainbow in a reduction of the spots the retention of parr marks and a notable increase of the number of scales There is little variation from the type in this trout

Regulation of Blood Salinity in Aquatic Animals Vol II Nos 1–6 of the Sydney University Reprints (Series 13 Zoology 1933) contains several papers conspicuous among them being Prof Dakin s and Miss E Edmonds work on the regulation of the salt contents of the blood of aquatic animals and the problem of the permeability of the bounding membranes of aquatic invertebrates reprinted from the *Australian Journal of Experimental Biology and Medical Science* 8 1931 The authors have found new subjects for investigation in the mangrove swamps setting up a temporary summer laboratory actually on the edge of the swamp in order to keep the animals in as healthy a condition as possible *Helaecius cordiformis* lives in the mangrove swamp not far from the sea in water of high salinity but subject to occasional freshenings of considerable extent after rain It is able to regulate the blood salinity in the sea water which is diluted with fresh water the blood being more saline than the surrounding medium the difference between the blood and the external medium becoming greater as the latter approaches fresh water It seems however to show a greater independence than other marine invertebrates so far investigated in that the blood tends to retain its normal constitution when the external sea water is made more concentrated It is shown that the changes in the blood salts which accompany changes in the outer medium are likely to be due to movements of salts or their ions inwards or outwards *Onchidium chameleon* increases in weight in diluted, and decreases in concentrated, sea water. Changes in the salinity of the external media are accompanied by changes in the body fluids, but the body wall acts more like a semi-permeable membrane and water movements through it are more facile than the passage of salts, which, however, also takes place.

***X*-Chromosome of *Drosophila*.** Through the work of Muller, Painter and others it is now recognised that about half of the *X* chromosome in *Drosophila melanogaster* is 'empty' of genes, and that this inert region is homologous with the *Y* chromosome. Mr. S. Gershenson (*J. Genetics*, 28, No. 2) has recently used for further study a strain with an *X* chromosome obtained through crossing over between two differently inverted *X* chromosomes, which therefore carries a duplication and a deficiency. The condition is lethal in *XX* females, but *XXY* females are viable. It was also found that the deficiency included the gene for bobbed bristles, but no other known genes. In males carrying this *X* chromosome, there was failure of synapsis between the *X* and *Y* in more than 60 per cent of the spermatogonia. In oogonia having this chromosome, one *X* was shown cytologically to be much shorter than the other. It is pointed out that such deficiency in the *X* would weaken the synaptic affinity between the *X* and *Y* and as a result the *XO* type of sex determination could be derived from the *XY* type. This work confirms the general views regarding the inertness of the *Y* chromosome and its similarity to the inert portion of the *X*. It also shows that genetical deficiency means the real absence of the corresponding portion of the chromosome.

Classification of Sesame. A recent study of the sesame (*Sesamum indicum*, L.) by Hildebrant (*Bull. App. Bot. Gen. and Plant Breeding*, 4, 4; 1932, Institute of Plant Industry, Leningrad), is based on 500 samples of seed collected by various expeditions; more than a third of these came from Central Asia and Asia Minor. As a preliminary to classification, the author deals with the variation in the characters of the plant in relation to geographical distribution. The species is divided into two sub-species according to the number of carpels in the capsule. A morphological basis is used for division into varieties. The mass of sesame in all countries is composed mainly of two varieties, the other varieties occurring mostly in mixtures with these varieties. The author considers Africa to be the primary centre of origin of the species, with India and Japan as secondary centres. Palestine appears to be the centre of high oil-yielding strains, the percentage of oil diminishing as one goes farther away from that country.

Nutrition of the Angiosperm Embryo. A very interesting general account of this subject is presented by René Souèges in the *Revue générale des Sciences*, 45, No. 5, of March 15. He shows how practically every tissue, either of the ovule or of the mature embryo sac, may be modified in ways that suggest a definite contribution to the nutrition either of the embryo sac itself or of the maturing embryo. Sometimes these adaptations take the form of remarkable haustorial constructions which are carried deeply into the chalazal end of the ovule or, in some cases, into the placenta by way of the micropyle. Although there may be little doubt that these structural features upon which emphasis is laid, contribute to the nutrition of the developing embryo, it must be admitted that the paths along which such transference of material takes place and the mechanism of translocation remain as yet entirely obscure.

Varieties of *Lilium candidum*. The *Gardeners' Chronicle* of April 7 contains a short article by the Abbé Souillet on *Lilium candidum* and its Varieties. This particular lily originated in Asia Minor, and in the wild state is extremely fertile, though small-flowered. The varieties *Charles X*, *peregrinum Salonica*, *spicatum*, *foliis variegatis* and *purpureo striatum* are described in detail, and particular attention is given to stability of form and fertility. It is interesting to note that the Abbé Souillet is attempting to breed a red *Lilium candidum* by crossing the female sterile variety *purpureo striatum* with the variety *Charles X* as the seed parent. Many of the varieties are subject to severe attacks by the fungus *Botrytis elliptica*.

Magmatic Problems. In his presidential address to the Geological Society of Washington, Dr. C. N. Fenner describes some striking cases of assimilation which seem to be incompatible with the requirements of the well-known theory of crystallisation differentiation advocated by Bowen and others (*J. Wash. Acad. Sci.*, 24, 113–124; 1934). According to this theory rhyolitic magma is produced by separation of crystals from a more basic parental magma, and it is therefore the coolest liquid of the series. It follows that if rhyolitic magma should engulf fragments of basalt it should normally be no more able to melt them or take them into solution than a cooling salt solution that had deposited crystals could redissolve those crystals on continued cooling. Dr. Fenner gives ample evidence, however, that both in the Katmai region and in Yellowstone Park, rhyolite magma has been able to dissolve large amounts of basic andesites and basalts. In one of the Yellowstone occurrences, assimilation produced homogeneous looking andesitic rocks. Analyses of two of these hybrids showed that they were respectively 30 per cent basalt plus 70 per cent rhyolite, and 69 per cent basalt plus 31 per cent rhyolite. Evidently there were heat reserves in the acid magma not recognised in the theory of crystallisation differentiation. In the Katmai region not even the reaction principle can be invoked, for here no precipitation of new minerals occurred. The contaminated magma became wholly liquid. The problem of heat supply is a difficult one, but it may be suggested that if the rhyolites were products of refusion in depth, the difficulty would be largely met.

Forecasting Rainfall in China. A paper entitled "China Rainfall and World Weather" by Chang Wang Tu (*Mem. Roy. Met. Soc.*, 4, No. 38) deals with the problem of forecasting the seasonal rainfall of China from statistical relationships—established as the result of a special inquiry—between the quantity to be predicted and the values of certain meteorological elements in various parts of the world previous to the rainy season. The method followed is that devised by Sir Gilbert Walker and others, who demonstrated the existence of large-scale fluctuations known as the North Atlantic, the North Pacific and the Southern oscillations. In this paper, China has been divided into four climatic regions: (1) the North China coast, (2) the Yangtse delta, (3) the Yangtse valley and (4) the South-east China coast. This division was found to be very necessary, the maps showing the correlation between the rainfall of the four divisions and contemporary deviations of pressure from normal in different parts of the world being very different The final achievement was the working out of equations for the seasonal rainfall using connexions with three or four distant centres, giving the equivalent of single total correlation coefficients having the following values North China coast (rainfall), June–September, 0 78, Yangtse delta, June–August, 0 62, Yangtze valley, May–August, 0 68, and South-east China coast, May–August, 0 68 The enormous loss of life and damage to property caused by floods in North China is well known, and some assistance towards prediction of these disasters will obviously result from any success in foreshadowing the seasonal rainfall For purposes of prediction a correlation coefficient of 0 78 is by no means negligible, results of practical value may therefore be hoped for in time

The Production of Positive Electrons Chadwick, Blackett and Occhialini have described a number of experiments on the production of positrons by various radiations (*Proc Roy Soc*, A, March) The positrons were examined in the usual way with a Wilson chamber in a magnetic field Positrons were produced in fair number when the hard γ rays of thorium C″ passed through lead, and the upper limit of their energy spectrum was consistent with the Dirac view that the energy of the γ ray was used in the creation of a negative and positive electron of approximately equal mass (requiring together about one million volts) and that the remaining energy is distributed between these particles By comparing the curvature of the positron tracks with the recoil tracks produced by Compton absorption of the γ rays, it was possible to get a fairly accurate upper limit to the positron energies, and accepting the Dirac view, the mass of the positron is found to be very close to that of the electron The probability of positron production in lead by the 2 6 million volt γ rays from thorium C″ may be as high as 0 2–0 3 of the probability of the liberation of an electron by the normal processes of scattering and absorption, and it is interesting to note that this is just sufficient to account for the anomalous absorption discussed by Gray and Tarrant and others (see NATURE, 133, 618, April 21, 1934) Further experiments showed that a large number of positrons come from a bare thorium active deposit source, as has previously been found by Thibaud, and it is probable that they have their origin in the radio active atoms themselves Experiments with the mixed radiation obtained by bombarding beryllium, boron or fluorine with α particles seemed to indicate that the neutrons as well as the γ rays may produce positrons in their passage through lead, though this may be an indirect effect in which a γ ray is first produced by the neutron

International Atomic Weights The report of the Committee on Atomic Weights of the International Union of Chemistry is now available (*J Chem Soc*, April, and *J Amer Chem Soc*, April) In the case of carbon, a higher value, 12 011, has been reported, but the Committee awaits further confirmation A long discussion of potassium is given, and the value 39 096 is adopted The value for arsenic has been changed from 74 93 to 74 91, and that of selenium from 79 2 to 78 96 Tellurium is changed from 127 5 to 127 61 The new value for cæsium, 132 91, agrees exactly with Aston's corrected value Erbium and ytterbium are changed to 165 20 and 173 04, respectively, osmium to 191 5, thallium is given the value 204 40, agreeing with Aston's 204 39, and some recent values for isotopes of lead are reported Although both Baxter and Alter and Hönigschmid, Sachtleben and Baudrexler obtained a value 207 21 for common lead, the value given in the table is 207 22

Dielectric Constants of Polar Solutions Observations on the dielectric constants of solutions of α amino butyric acid and glycine in water show that the dielectric constant is a linear function of concentration (mol/litre) to the highest concentrations studied (Wyman, *J Amer Chem Soc* March 1934) For the same solute in different solvents (water, ethyl alcohol solutions, urea solutions, α aminobutyric acid in glycine solutions and vice versa) the increment δ in dielectric constant per mol of ampholyte added to the solution is practically constant whilst the dielectric constant of the solvent varies considerably In polar solvents, therefore, the dielectric constant is a nearly additive property The results are interpreted by the assumption that the polarisation per c c is linear in concentration which implies that the effective field F shall be the same as the intensity E, the contribution of polarisation, F_2, being equal and opposite to the polarisation, F_3, due to dielectric inside a small sphere surrounding a molecule F_3 is usually neglected in dielectric theory Thus $(\epsilon \quad 1)/3 = p$ (polarisation per c c) is obtained in place of the classical equation $(\epsilon - 1)/(\epsilon + 2)\rho = p'$ (polarisation per gram, ρ = density) This leads to much larger values for the polarisation when ϵ is large, and these are supposed to represent better the assumed polarisations of zwitter ions of ampholytes

Automatic Arc Welding The use of the electric arc for welding metal plates is rapidly increasing and doubtless affects the employment of riveters Many attempts have been made to develop an automatic arc welder, which will still further affect the market for skilled manual labour The automatic welder feeds the electrode over its required path by a special mechanism The automatic control of the electrode feed keeps the arc constant so that even an unskilled labourer can work it Continuous operation is possible as the electrode wire is coiled on a reel This avoids the dangers of porous welds, which are apt to occur with hand welding owing to the necessary interruptions for changing the electrodes With the machine, the current enters the electrode close to the arc and thus larger currents can be used In the *Asea Journal* of January (Allmänna Svenska Elektriska A B), a full description is given of the new Asea Ipsoweld automatic welder The drawbacks to earlier designs of automatic welder seem to have been overcome In particular this machine can weld longitudinally, transversely and round circles and other forms of curve It is suitable for either indoor or outdoor use A rough estimate is given that an automatic machine can replace two or three hand welders Placing the yearly cost of one hand welder at £200, the saving per year would be at least this sum It is concluded that an automatic welding plant working full time pays for itself in two years Carbon electrodes only burn at the rate of eight inches per hour and the amount of filling wire used per hour is about 4½ lb

Some Exhibits at the Royal Society Conversazione

THE first of this year's conversaziones at the Royal Society, held on May 9, produced as usual a number of interesting exhibits and demonstrations Several have been the subject of recent communications in our correspondence columns, and descriptions of some of the remainder taken from the programme are printed below

Mr George H Gabb showed a telescope of 1646 by Maria de Rheita, which is the earliest known dated optical instrument in the world Maria de Rheita (1597 1660) a Capuchin Bohemian monk whose name was Antonius V Schyrle before his monastic conversion was the first to invent a terrestrial telescope with an image erecting eyepiece of three lenses He described its construction in a folio work Oculus Enoch atque Eliæ', published in 1645 a copy of which is in the library of the Royal Society No example of his telescopes was hitherto known to have survived

Mr Henry Balfour showed an interesting collection of stone implements from Tasmania from the fashioning of which the culture of the Tasmanians is regarded as corresponding to that of Cromagnon man in Europe

Mr R W Paul exhibited a simple apparatus for prolonged artificial respiration, which was designed at the suggestion of Sir William Bragg It has already been used in one case of progressive muscular atrophy unceasingly for a period of eight months, and has prolonged the life of the patient, who, without aid, would die in less than two minutes It comprises three main units (1) an inflatable air bag, or belt encircling the chest, (2) a pulsator which rhythmically inflates the air bag, and (3) a controller governing the speed of the pulsator The pulsator on its upward stroke inflates the air bag causes a pressure to be applied to the chest and squeezes air out of the lungs On the downward stroke of the pulsator, air is released from the bag the chest resumes its normal position and air is inhaled The volume of air inhaled can be varied by altering the pressure in the air bag The apparatus is silent and automatic in operation, simple to adjust and easily transportable

Dr W R Jones showed microscope preparations illustrating his view that minerals other than uncombined silica can cause silicosis Sections of many silicotic lungs show innumerable acicular fibres of sericite, a silicate of aluminium and potassium, which greatly outnumber the quartz particles In the Kolar Goldfield India silicosis is rare, and sericite is also rare in the Kolar quartz, on the other hand, the gold bearing rock worked on the Rand contains sericite and many cases of silicosis occur

The Entomological Department, Rothamsted Experimental Station (Dr C B Williams and Mr D Morland) showed a light trap, which catches and kills the insects attracted to it at night and sorts them into eight groups according to the time of night at which they enter The captures are correlated with various weather conditions including temperature, wind, humidity, the cloudiness of the sky and the duration of moonlight A photoelectric method of measuring the cell space ratio in woods was demonstrated by the Forest Products Research Laboratory The quantity of light transmitted by a suitably stained micro section of the wood is measured as a percentage of the total quantity of light falling on the section By adjusting the magnification of the projected image of the section measurements may be made either on an integral number of annual rings, giving an average value of the cell space ratio, or on a small area confined to the spring or summerwood separately Dr F G Gregory and Mr H L Pearse showed a self recording apparatus for measuring changes in aperture of stomata A glass cup attached to the lower side of a leaf by a gelatine washer is connected in series to a constant pressure aspirator through a variable capillary resistance, and air is thus drawn through the stomata The pressure between the leaf and the resistance is recorded by a manometer, the varying level in which interrupts a beam of heat focused on a linear thermopile

Some silica glass from the Libyan Desert was shown by Dr L J Spencer (Department of Mineralogy, British Museum (Natural History)) This material was recently discovered by Mr P A Clayton during the work of the Egyptian Desert Surveys in the unexplored region bordering on Italian Cyrenaica about 500 miles south west of Cairo The material is a nearly pure silica glass containing SiO_2 97 58 per cent, pale greenish yellow in colour and makes an effective gemstone It is quite distinct from the fulgurites formed by lightning It resembles most closely the still problematical tektites, the presence of a trace of nickel suggests a relation to the silica glass found around meteorite craters

Sir Gilbert Walker and Mr A Graham demonstrated the formation of artificial clouds If a layer of liquid or air at rest is heated below or cooled above the vertical instability will produce motion in polygonal cells, but if the fluid moves with considerable shear there will be longitudinal cells parallel to the direction of the shear In air, a slow shear produced by sliding along the glass top of the containing trough produces transverse cells and an intermediate velocity a rectangular pattern These can be identified with cloud forms Prof E J Baldes demonstrated micro methods of measuring vapour pressure It can be shown theoretically that the vapour pressure thermopile consisting of 50 couples of constantan silver, with wires of high thermal conductivity, is inefficient and that similar measurements can be made with a single thermocouple The technique of measuring vapour pressures of small drops of liquid (1 mgm or less) suspended from the junctions of a thermocouple was demonstrated Mr R C Brown showed some methods of studying capillary waves Ripples produced on a liquid surface by a point or line-source maintained by a valve oscillator are made to appear stationary by intermittent illumination of the same frequency The frequency is determined by connecting an Osglim lamp across the oscillator output and allowing this to illuminate a stroboscopic disc controlled by a 50 cycle tuning fork Thus measurements of wave length and amplitude can be made over a range of frequency, the validity of Kelvin's equation tested, and surface tensions measured It is also shown that a liquid surface over which ripples are passing may be used as a plane reflecting diffraction grating for visible light

Prof E G Coker and Prof A V Hill combined to show some experiments on thermo elasticity The adiabatic thermal changes during extension and compression of materials have long been known, but measurement has been difficult By employing a radiation thermopile and a galvanometer of high sensitivity and short period the thermal effect of loading a specimen can be read on a scale, or recorded photographically, in a few seconds The stresses in rigid materials can be measured with an accuracy comparable with any other known form of measurement, and strange to say, the order of the measurements depends on the coefficient of expansion of the material employed and not on Young's modulus and Poisson's ratio as in some other methods Steel, brass, vulcanite and other bodies possessing a coefficient of expansion or contraction confirm this In cases of plane complex stress, the measurements give the sum of the principal stresses The adiabatic compression of various liquids, including water, has also been measured in this way, at pressures up to 1,500 lb per sq in and the simple thermo electrical arrangements used are such that the range of pressures can be extended almost indefinitely

The Metropolitan Vickers Electrical Company Ltd , exhibited a portable noise measuring apparatus, working on the aural balance principle It consists essentially of a valve oscillator, a calibrated attenuator and a telephone earpiece The oscillator generates current at 800 cycles which is fed to the telephone through adjustable attenuators The apparatus is calibrated so as to indicate directly the intensity of the 800 cycle tone in the telephone in decibels above threshold of 0 0003 dynes/sq cm , measured in the ear or 0 00021 dynes/sq cm , measured in free space The observer places the telephone on one ear and presents the other to the complex noise to be measured He then adjusts the attenuators until he judges the loudness of the 800 cycle note heard in the telephone to be equal to that of the complex noise The equivalent value of the complex noise is then read in decibels above threshold from the settings of the attenuators

A fractional seconds chronograph was shown by Mr E A Nehan (Mathematical Department, Imperial College of Science) This instrument is designed to record visibly on paper tape, 0 01 sec at 1/10th inch scale, up to four events simultaneously A tuning fork controls a synchronous motor, which through a 3 speed gear gives motion to a printing train and paper feed at the selected speed Four inking pens record any event, translated as a simple make and break circuit, which mark on the tape is squared down to the time scale printed on the tape The machine is portable, self-contained and worked from a 12 volt accumulator Mr J Harvey, of the same Department, showed an integrator By rolling a horizontal spur wheel on a rack in one direction and moving the rack perpendicularly, the axis of the wheel can be made to trace a curve whose Fourier coefficients are required The wheel makes n turns over a range of rack representing $0 - 2\pi$ On a horizontal arm fixed to the axle of this wheel, is a wheel which rolls on the paper and registers the coefficients a_n and b_n Six harmonics can be found The mechanism is adapted to find area, and first and second moments of area about an axis, on the principle of Amsler's moment integrator

The National Physical Laboratory (Mr R A Watson Watt, Mr J F Herd and Mr L H Bainbridge Bell) showed a cathode ray tube which has been made to serve as a magnetic compass The cathode ray beam is deflected by the earth's magnetic field and may therefore be used as a compass needle free from inertia In the present instrument light signals controlled by collector electrodes in the tube indicate any change in the magnetic bearing of the platform carrying the tube Changes of a small fraction of a degree can be indicated Among the exhibits by the Director of Scientific Research Admiralty was an apparatus which enables the deaf to hear by bone conduction Amplified currents from a microphone are supplied to a coil wound direct on to a straight nickel iron wire which has a high magnetostriction coefficient The wire vibrates with the frequency of the current and the vibrations may be transmitted to the cochlea through the bones of the head or jaw either by clenching the wire in the teeth or by pressing it on the mastoid bone behind the ear The same Department also showed an automatic radio direction finder This instrument is of the Bellini Tosi type comprising two crossed frame coils and a goniometer the search coil of which is rotated by an electric motor The goniometer is connected to a radio receiver followed by a special rectifier and relay system which reverses the direction of the electric motor whenever the high frequency current in the search coil increases, thus, since the direction of rotation of the search coil is reversed whenever the minimum is passed, the search coil hunts a position at minimum

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Interpretation of Evidence for the Recession of Nebulæ

AT Oxford on Tuesday, May 8, Dr Edwin Hubble, of the Mount Wilson Observatory, delivered the Halley Lecture on 'Red Shifts in the Spectra of Nebulæ" As is indicated by the title the lecture was concerned with a non speculative account of those investigations, largely due to Dr Hubble himself, which have led to the far reaching speculations of de Sitter, Eddington, Milne, and others on the expansion of the universe After a masterly account of the use of Cepheid variables in determining the distances of the nearer extra galactic nebulæ, of the statistical methods involving the intrinsic luminosity of the average nebula for the distances of the remoter objects, and of the radial velocities or red shifts measured by Slipher and Humason, Dr Hubble developed in full the velocity-distance relation which bears his name For the 150 nebulæ of which spectra have now been obtained and which lie within a sphere of 150 million light years radius, he was able to show that the red shifts, expressed as velocities, increase linearly by roughly one hundred miles per second for each million light years of distance, further, he was able to show that the difference between the linear relation for isolated nebulæ and for clusters of nebulæ is wholly the effect of selection, and thus to harmonise the results from all observed nebulæ

The lecture concluded with an attempt to interpret the observed red shift on the basis of the available observational material alone If the red shift is produced by some unspecified cause, Doppler effect being thus expressly excluded, then the brightness of the nebula will be reduced by the factor $(1-d\lambda/\lambda)$ because each quantum carries less energy, and also roughly by the same factor again because the weaker ultra violet part of the spectrum is displaced into the photographic region (the correction from bolometric to photographic magnitude). If, on the other hand, the red shift is due to an actual velocity of recession, then not only does each of the two previous effects reduce the brightness in the ratio $(1-d\lambda/\lambda)$, but also there is a reduction by a similar factor because the nebula is receding and fewer quanta reach the photographic plate per second. From counts of nebulæ made to five different apparent magnitudes, the numbers of nebulæ in each of the five corresponding spheres of increasing radius can be found, the radius of each sphere being given by the intrinsic luminosity of the average nebula and its apparent luminosity, corrected either by $(1-d\lambda/\lambda)$ for pure red shift, or by $(1-d\lambda/\lambda)^2$ for red shift interpreted as velocity of recession.

These counts indicate that, if the red shift is due to velocity, then the number of nebulæ per unit volume must increase rapidly with increasing distance —a somewhat startling result; on the other hand if the red shift is not produced by a Doppler effect, then the counts indicate that the nebulæ are uniformly distributed over the sphere of 350 million light years radius which is within the range of the 100 inch reflector at Mount Wilson. While this particular result was not stressed by Dr. Hubble, he concluded by pointing out how the completion of the 200 inch reflector will enable such counts and velocity determinations to be extended over a far larger volume of space, and will thus permit a definite interpretation of the red shift, either as due to velocity of recession, or as due to some other yet unknown physical cause.

Decrease of the Barn Owl in England and Wales

PRECISE knowledge of the standing of particular birds in Britain should result from the increasing number of national censuses which have been initiated in recent years. Where the statistical information is thorough, it will form an invaluable basis of comparison with similar data gathered in future years; even where statistics have been dropped and reliance is placed upon the opinions of many observers scattered over a wide area, the consensus of opinion may still be a reliable guide to the fluctuations of the population.

Both kinds of information have been utilised in a census of the barn owl in England and Wales, made between May and December 1932, the results of which have been summarised by G. B. Blaker in an attractive pamphlet published by the Royal Society for the Protection of Birds. By making reasonable estimations in areas where direct information was not forthcoming, the author assesses the total breeding population of barn owls (*Tyto alba*) in England and Wales at 12,000 pairs. Non-breeding birds averaged one to every 50 square miles, so that the total adult population of barn owls in the summer of 1932 was about 25,000 individuals.

The absolute number is not so important as knowledge as to what relation it bears to that of former years, and here the statistics of one season, which contain no time element, cannot help. But putting one scrap of evidence regarding former conditions with another, Mr. Blaker has no difficulty in coming to the conclusion that the fears of those who suspected a serious decline in the numbers of the barn owl are justified. "From all districts in central and southern England the reports brought the same tale—fewer occupied nests than a few years ago. In parts of Essex and Suffolk the decline was less marked, while in Devon and Cornwall the barn owl seems to be holding its own. Northumberland, Cumberland and Westmorland are the only counties to record an increase."

The decline in numbers over the greater part of the country appears to be no new thing: it has been noted for the last thirty or forty years. The disturbing point is that it has been speeding up during the last six years or so, until it has reached a point when so far as the records can be interpreted, about four per cent of the population (or 1,000 birds) disappears annually; this, of course, over and above the annual wastage which would keep the population at a steady number.

Several factors contribute to the falling numbers of the barn owl. Nesting sites are fewer, partly because church authorities object to the occupation of towers and belfries by the ghostly 'cherubim', and fence the old nesting holes with wire entanglements; partly because modern barns with corrugated iron roofs do not offer openings like the 'owls' windows' of the old type. Food is probably more scarce since 'rat weeks' were instituted and the farmer has generally intensified his campaign against vermin. This has had a further effect in that the methods of destroying rats by poison has, the evidence indicates, resulted in the poisoning of owls which have devoured living but poisoned rats. Finally, there is the deliberate destruction of barn owls by people who should, but seemingly still do not, know better.

The author suggests, without definitely formulating the charge that inefficiency of the Wild Birds Protection Acts is involved in the decline of the barn owl, but he states quite clearly the crux of this matter, namely, that it is in the administration of the law that the weakness, if any, lies. Were the critics of the present Birds Protection Acts to report the offences and insist with witnesses upon the prosecution of the offenders (and they seem to be well supplied with instances of law breaking), they would be making a contribution of value to the working of the law, and making no more of a contribution than the laws in question expect and make provision for them and other well disposed citizens to make. But indeed, with regard to the barn owl, it is legitimate to ask whether the probability is that its present status would have been better or worse had there been no bird protection laws, and further why, if the law is a source of evil, the brown owl should have increased in numbers so enormously in the years when the barn owl has been declining? J. R.

University and Educational Intelligence

BIRMINGHAM.—Mr. Stuart McDonald has been appointed lecturer in pathology in succession to Dr. F. W. M. Lamb, who has been appointed professor of forensic medicine at Cairo.

CAMBRIDGE.—Dr. W. W. Watts has been appointed to represent the University at the centenary of the Edinburgh Geological Society on September 3–4.

At St John's College, A V Stephens has been elected to a fellowship Mr Stephens gained a first class in the Mechanical Sciences Tripos in 1930 with distinction in aeronautics and the award of the Seeley Prize For the last three years he has been engaged in scientific research at the Royal Aircraft Establishment, Farnborough, and has conducted experiments and published papers on the spinning of aeroplanes

In Congregation on May 11, the degree of Sc D was conferred on John Read (Emmanuel College), professor of chemistry in the University of St Andrews and formerly professor of organic chemistry in the University of Sydney Prof Read is the author of publications on organic chemistry and historical chemistry, and is known also for his original investigations on stereochemistry, terpene chemistry, and the chemistry of Australasian natural products

SHEFFIELD —Mrs Edward Mellanby has been appointed honorary lecturer in the Department of Physiology

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The following Commonwealth Fund Fellowships, among others, tenable by British graduates in American Universities for the two years beginning September 1934, have recently been awarded R N Arnold (Glasgow and Sheffield) to the University of Illinois, in engineering , Stewart Bates (Glasgow and Edinburgh), to Harvard University, in economics , J H Brown (Glasgow and Oxford), to the University of California, in philosophy , Philip Chantler (Manchester) to Harvard University, in economics , C J M Fletcher (Oxford) to the University of California, in chemistry , E N Fox (Cambridge), to the University of Michigan, in engineering , E G Hancox (Liverpool and Imperial College of Science and Technology), to the University of Arizona, in geology , Joseph McGinn (Armstrong College, Newcastle), to Harvard University, in business administration , F G W Smith (Imperial College of Science and Technology), to Princeton University, in zoology , A D Thackeray (Cambridge), to the California Institute of Technology, in astrophysics , J C Trevor (Oxford), to Northwestern University, in anthropology , A G M Weddell (St Bartholomew's Hospital Medical College), to the University of Rochester, in medicine , Shaun Wylie (Oxford), to Princeton University, in mathematics

The following have been appointed to fellowships tenable by candidates from the British Dominions M M Burns (New Zealand and Aberdeen), to Cornell University, in agriculture , James Melville (New Zealand and Imperial College of Science and Technology), to Yale University, in biochemistry

The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas J D W A Coles (Witwatersrand and Department of Agriculture, South Africa), to Washington University, in veterinary science , Dr R H Le Pelley (Imperial College of Science and Technology and Department of Agriculture, Kenya Colony), to the University of Illinois, in entomology , H E McMillan (Saskatchewan and the Department of Agriculture, Canada), to the University of California, in entomology , E A Moore (Bristol and the Irrigation Department, Bengal), to the University of Illinois, in engineering , C W O Turner (Wales and the Public Works Department, New Zealand), to Stanford University, in engineering.

Science News a Century Ago

Poinsot and Poisson

Among the journals of a century ago which recorded scientific events were the *Athenæum*, from which the following note is taken It was at a sitting of the Paris Academy of Sciences on May 20 that M Poinsot commenced reading his memoir, a New Theory of the Rotation of Bodies", in which he presented new views Having arrived at these by a direct consideration of the nature of rotation, M Poinsot launched out into praise of the mode of discovery and spoke at the same time in terms rather slightingly of the analytic and algebraic modes of examining a question M Poisson, an academician of the analytic school, took fire at these reflections and came down the next week with refutations M Poinsot rejoined, instancing a mistake made by D'Alembert During the discussion, divers allusions, so the writer said, were made such as in a certain honourable house would have called for the interference of the 'Speaker' Upon the whole, the synthetic method seemed to have had the best of the argument, although M Libri, the Florentine geometer, joined his anger and argument to those of M Poisson

London Mechanics Institution

The tenth anniversary of this institution, now known as Birkbeck College, was held in the theatre of the institution in Southampton Buildings, Chancery Lane, London, on May 22, 1834 Dr Birkbeck presided over an audience which included many distinguished literary and scientific men After some preliminary remarks by Dr Birkbeck and the award of the prizes, five resolutions were passed The third of these was that the manifestation of talent developed within the walls of this institution shown on the present, as on former occasions, is a proof of the wisdom of the plan here first widely called into practice of disseminating useful science through the industrious classes of the community and gives substantial earnest that through the agency of these self ruled and self supported establishments the barbarism of ignorance, with its concomitants, vice and misery, will be more rapidly dispelled and the moral, the intellectual, and the social condition of man be raised to that higher level which becomes his character as a rational and responsible being" By the fifth resolution the meeting offered 'its unalloyed congratulations to Dr Birkbeck on the steady advancement and the present state of this flourishing and useful institution over which he has from its foundation paternally and anxiously presided without deviation, and that the most hearty thanks of this meeting are due, and are hereby presented to that able individual for the powerful assistance given to this institution on this and every occasion"

The Franklin Institute

At the monthly conversation meeting of the Franklin Institute held at Philadelphia on May 22, 1834, Prof Johnson made experiments on the centrifugal force of liquids, in refutation of certain statements made by M Thayer, in a paper read to the French Institute, an outline of which had been given in the *Revue Encyclopedie* of September 1833 The liquids used were oil, water, alcohol and mercury, and the experiments embraced the cases of rotation about the axis of a vessel in which the oil and water were placed, as well as the vibration of the vessel containing alcohol, water and mercury

At the same meeting Dr Jacob Green exhibited an electromagnetic apparatus by Dr Henry for the production of reciprocating motion, by the combined action of electromagnetic currents and of permanent magnets, and Prof A O Bache showed apparatus for the polarisation of light This apparatus had recently been imported for the Friends College at Haverford The polarising effect of the tourmaline was seen by a simple arrangement of two plates of that mineral cut parallel to the axis and fitted with wire rings so as to admit of rotation while the planes remain parallel to each other

The Duke of Sussex's Soirées

His Royal Highness the Duke of Sussex as president of the Royal Society, manifests a liberality and courtesy highly honourable to himself, and entitled to imitation by other noble and eminent persons who are advanced to similar stations by the members of their respective societies Occasionally, during the winter season, his Royal Highness invites some of the leading members of the Royal Society to dine with him at Kensington Palace, and on the same evening receives a large assembly of visitors from 9 to 12 o clock On these occasions many of the first nobility and gentry of the country thereby meet some of the most eminent men of science professors of the fine Arts, and literary characters

The presidents of the Astronomical Society, Mr Baily—of the Geological Mr Greenough are in the habit of having frequent dinner and evening parties of the members of their respective societies and thereby contribute very materially to promote science and a friendly intercourse amongst its lovers and patrons These gentlemen are rarely ever absent from their presidential duties and thus manifest a laudable zeal and a positive attachment to that science over which they are elected as professional guardians

Two of the Duke of Sussex's meetings have taken place since Christmas and two others named on the invitation cards For the purpose of gratifying the company and furnishing matter for conversation, various objects of art science, vertu literature, etc , are placed on the tables and the choice treasures of the library are accessible through the obliging attentions of Mr Pettigrew his Royal Highness's librarian The unrivalled collection of Bibles is a source of great interest to many persons Among other objects exhibited have been a series of marbles of different countries and qualities, on which Mr C H Smith has lectured , a model of a machine for polishing lenses a very curious model of the Great Pyramid of Egypt, made by Mr Davidson , and a series of drawings illustrating the architectural antiquities of different ages and different countries, being part of Mr Britton's extensive series for his lectures ' (*Gentleman's Magazine*, May 1834)

London Horticultural Society and Garden

"The Anniversary Meeting took place, when a report on the affairs of the Society was read, and officers elected It appears that there has been a surplus of income over expenditure for the year ending March 31 1834, of 1574l 18s 7d Out of this sum the Society have paid off two bonds amounting to 920l , leaving the gross amount of the debt at 17,602l 11s 9d , which, there can be no doubt they will soon be able to discharge The Show at the Gardens on May 10 was the best that has yet taken place The first striking object on entering was the Wistaria Consequana, covered with some thousands of bunches of flowers , most of which were expanded to the point of their greatest beauty and but a few so far have begun to drop their corollas ' (*Gardener's Magazine*, May 1834)

Societies and Academies

PARIS

Academy of Sciences, March 19 (*C R* , 198, 1089 1192) The president announced the deaths of Camille Matignon, D H Scott and W M Davis E Fichot Poincaré waves of the second species J Costantin Exteriorisation of degenerations by the action of altitude Discussion of the effects of growth at high altitudes on plant diseases A Gosset, Joseph Magrou and A Tchakirian The action of various elements on the bacterial tumours of *Pelargonium* Of various elements introduced only salts of germanium showed a selective action on the tumours and the effect was not permanent Gabriel Bertrand and Pierre Serbesca Does the daily injection of small quantities of aluminium favour cancer ? The author s experiments on rabbits lend no support to the view that aluminium is toxic and predisposes to cancer M Haimovici The general spaces which correspond point by point with conservation of the parallelism of Cartan Serge Rossinski A transformation of minimal surfaces Alfred Rosenblatt A biharmonic non linear equation with two independent variables in a general domain G Vranceanu A classification of the equations of a Pfaff system B de Kerékjartó The regularity of the transformations of a simply transitive continued group N Lusin A new property of measurable *B* ensembles Mlle H Szmuszkowiczowna A theorem on polynomials and its application to the theory of quasi analytical functions E Vessiot The refraction and reflection of waves Florin Vasilesco A manner of considering the study of plane movements with ridges independently of the theory of functions with complex variables Antoine Appert Some remarks on the Poisson stability in the Poincaré sense Crestin and Campredon Study of the deformations and of the distribution of the internal forces in a piece of wood by means of an adherent film Description of a method applicable to material to which, on account of non isotropic properties photoelastic methods are inapplicable Louis Besson Total radiation measured by the Bellani lucimeter L Dunoyer The expansion of fused silica A negative coefficient of expansion of fused silica over a certain range of temperature has been proved André Egal Thermoelectric meter compensated for all fluids An instrument for measuring the rate of flow of fluids is described and illustrated René Reulos The deduction of the laws of electrodynamics starting from certain solutions of the equation of electric waves Mlle M Quintin and A Lebettre Study of the chain lead, lead sulphate, copper sulphate, copper A Portevin, E Pretet and H Jolivet : Displacement of the

Curie point with concentration in iron nickel tungsten (or molybdenum) austenites Pierre Chevenard The thermomagnetic study of the heterogeneity of an iron nickel-carbon chromium austenite after precipitation of the carbide after annealing Emile Henriot The couples exerted by circularly polarised light Gilbert Cahen A method of calculation for thick glass projector mirrors G Sannié A recording photoelectric photomicrometer with neither slit nor amplification Guy Emschwiller The chemical action of light on the diiodo derivatives of hydrocarbons the diiodoethenes P Mondain Monval and René Paris The thermometric study of the formation of inorganic complex compounds Results of a calorimetric study of the formation of mercury potassium iodide and of the double cyanides of nickel zinc and cobalt F Rouyer The cryoscopic determination of the total hydration of the ions of strontium chloride Paul Renaud A new compound of phosphorus nitrogen oxygen and hydrogen The hydrolysis of the compound PN obtained as a product of the reaction between phosphorus trichloride and ammonia gives a new compound H_4NO_2P the properties of which are recorded H Muraour and W Schumacher The combustion of compressed mercury fulminate in a vacuum Jacques de Lapparent The deposition and geological position of the bauxites of Greece Pierre Comte The layers intermediate between the Silurian and Devonian in Asturia Lefèvre The division and elongation of the cells in the genus *Closterium* Raymond Hamet The presence of entirely woody supernumerary bundles in the cortical parenchyma of *Echeveria* Henri Prat Remarks on the epidermal characters of the American species of the genus *Agropyrum* Marc Simonet The regularity of the chromatic reduction and the perfect pollen constitution of a hybrid between species with unequal numbers and aneuploids of chromosomes (*Iris autosyndetica*) M M Janot The action of the female crystallised hormones on the development of some plants Equiline equilenine folliculine and dihydrofolliculine force the growth of hyacinths and lilies of the valley Ad Davy de Virville Observations and experiments on the variations of alkalinity in sea water pools Jules Amar Diuresis and metabolism Paul Wintrebert The laws of epigenesis in amphibians Mlle Irène Goldberg and Jacques Monod The rôle of the symbiotic chlorellæ in the nutrition of *Paramecium bursaria* Léon Binet and Georges Weller A new method for the estimation of glutathione The method is based on the insolubility of a compound of glutathione with cadmium Mlle Berthe Delaporte The structure and process of sporulation of *Oscillospira Guilliermondii* Maurice Doladilhe Some physical properties of blood serum

CRACOW

Polish Academy of Science and Letters, February 5 M Petrovitch A class of algebraic differential equations of the second order A Jablonski The polarisation of the fluorescence of colouring materials as a function of the wave length of the exciting light For the dyes studied the amount of polarisation generally decreased with the wave length of the exciting light, and the effect appears to be due to the fluorescent molecule and not to the medium supporting it These phenomena cannot be accounted for by any current theories (see also NATURE, 133, 140, Jan 27, 1934) Mlle M Moraczewska The distribution of the intensities in the resonance line Hg 2537 A emitted in different directions W Swietoslawski and Mlle F Bartoszewicz Abnormal thermal effects produced by certain minerals and certain chemical substances Experiments made with the adiabatic calorimeter W Swietoslawski Some improvements of the adiabatic calorimeter used for the measurement of minute thermal effects The alterations remove the possibility of errors arising from bad working of the thermo electric battery I Zlotowski Studies of the cathodic polarisation of metallic electrodes by means of the Heyrovsky and Shikata polarigraph The author deals with the cathodic polarisation of solid metallic electrodes the phenomena of overvoltage of metals and the theory of the overvoltage of hydrogen W Jacek The velocity of solution of marble in acids (4) K Smolenski and W Kozlowski The influence of sucrose on the *p*H of alkaline solutions The authors conclude that the lowering of the *p*H by sucrose is an effect caused by the acid character of the sugar The dissociation constant is calculated as $K = 1.5 \times 10^{-13}$ K Smolenski and A Zelazny The velocity of crystallisation of sucrose Cz Kuzniar The Stebnik glaseritic rocks Mlle H Wysocka Remarks on the ecology and sociology of the sphagnophilous Desmidiæ of the neighbourhood of Warsaw J Tur The undulating parablast J Gallera Experiments on the action of subblastodermic pressure on the embryos of birds E Loth Cinematography considered as a new method of research in macroscopic anatomy W Gajewski Monographic study of the association of *Avenetum desertorum*

WASHINGTON D C

National Academy of Sciences (*Proc* 20 1 92 Jan 15 1934) William K Gregory Polyisomerism and anisomerism in cranial and dental evolution among vertebrates Polyisomerism is defined as a state in which many homologous parts, or polyisomeres are arranged along any primary or secondary axis whether curved or straight anisomerism is the state in which one or more parts are emphasised at the expense of the rest while the original number of parts is usually reduced by fusion or elimination The forces producing these states are extended in time are repeated and are subject to rhythmic acceleration and retardation Adaptive radiation results from the summation along divergent lines of the results of secular polyisomerism and its opposites anisomerism and hyperpolyisomerism Hans Zinsser and M Ruiz Castaneda Active and passive immunisation in typhus fever It has proved possible to prepare a serum from a horse treated with killed vaccines of Mexican typhus, which gave immunity to the European form of the disease in experimental animals It is suggested that the two forms of typhus are due to organisms of the same group with fractional antigenic differences caused by passage through different animal and insect vectors G Lemaitre Evolution of the expanding universe Applying the law of gravitation to a region of extremely low density, and allowing for fluctuations of density and velocity about the mean value, it is concluded that the system includes collapsing regions distributed in the generally expanding space and occasionally equilibrium regions The collapsing regions are identified with the extragalactic nebulæ and the equilibrium regions with the clusters of nebulæ (See also NATURE April 28, p 654) William Hovgaard An investigation of the stresses in longitudinal welds A theoretical discussion based on experimental work on partially welded girders W H Ingram On the dynamical theory of electrical commutator machines Cyrus H Fiske The nature of the depressor substance of the blood A method used for the separation of adenosine triphosphate from protein free muscle filtrates, used at a temperature of 0° C , gives with fresh rabbit blood a substance which is indistinguishable from adenosine triphosphate M Demerec Effect of X rays on the rate of change in the unstable miniature 3 gene of *Drosophila virilis* No significant change was observed with 600–1,800 *r* units of radiation Regarding the gene as a complex organic molecule, which may be stable or unstable the system of genes is like a balanced action The effect of X rays is to change the position of balance , this may account for the slight changes observed C W Metz Evidence indicating that in *Sciara* the sperm regularly transmits two sister sex chromosomes Curt Stern On the occurrence of translocations and autosomal non disjunction in *Drosophila melanogaster* No translocations between chromosomes I, II and III were found Non disjunction of the autosomes in males was frequent Donald F Jones Unisexual maize plants and their relation to diœcism in other organisms Diœcious maize has been produced from normal plants by combining two recessive genes located on different chromosomes R L Moore Concerning compact continua which contain no continuum that separates the plane Marston Morse Does instability imply transitivity ? E K Haviland On distribution functions and their Laplace Fourier transforms Aurel Wintner On the asymptotic formulæ of Riemann and of Laplace H Bateman Functions orthogonal in the Hermitian sense a new application of basic numbers Paul S Epstein The expansion of the universe and the intensity of cosmic rays Zwicky has pointed out that the distance a light quantum can travel may be limited by the operation of the astronomical red shift Linear extrapolation of the red shift leads to a very short time scale for the universe, namely, 1 8 × 10^9 years The high observed intensity of cosmic rays requires the introduction of Einstein s cosmological constant The types of expansion of the universe and their time scales are discussed Arthur H Compton Scientific work in the *Century of Progress* stratosphere balloon The balloon rose from Akron on Nov 20, 1933 to a height of 18,665 metres and descended eight hours later near Bridgeton N J Skylight at 90° from the sun was completely polarised Above the highest layer of haze, the colour of the sky shaded through green to a deep blue, deficient of any purple hue Radio signals were well transmitted on a wave length of 19 7 metres The temperature of the top of the balloon rose to – 2° C but the air temperature was about – 55° C During the descent, the gondola was opened at 8 1 kilometres, without any bad effects on the observers, due apparently to the short exposure to the very low pressure or high concentration of oxygen in the gondola Cosmic ray observations were made successfully, but an unexpected rapid rotation of the balloon prevented the completion of the directional experiments G H Shortley and G E Kimball Analysis of non commuting vectors with application to quantum mechanics and vector calculus Oswald Veblen and A H Taub Projective differentiation of spinors.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Tuesday, May 22

University of London, at 5 15 —(at University College) —Prof W Vogt ' Experimental Vertebrate Anatomy (succeeding lectures on May 24 and 25) *

Bedford College for Women, at 5 15 —Prof David Katz 'Some Problems of Perception in Modern Psychology (succeeding lectures on May 23 and 24) *

Official Publications Received

GREAT BRITAIN AND IRELAND

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1564 (S and C 466) Further Experiments on a Model Fairey IIIF Seaplane By A S Batson and A G Gadd Pp 6 + 8 plates 6*d* net No 1565 (Strut 140) Elastic Instability of a Thin Curved Panel By S C Redshaw Pp 15 9*d* net No 1568 (T 3437) Calculation of Critical Reversal Speeds of Wings By D M Hirst Pp 24 + 3 plates 1*s* 3*d* net No 1569 (T 3433) The N P L Open Jet Wind Tunnel By A R Collar Pp 17 + 10 plates 1*s* net No 1572 (T 3466) An Improved Multitube Tilting Manometer By Dr R Warden Pp 6 + 2 plates 6*d* net (London H M Stationery Office)

The Academic Assistance Council Annual Report 1st May 1934 Pp 14 (London Academic Assistance Council)

Report of the National Baby Week Council 1933 presented and adopted at the Seventeenth Annual Meeting of the National Baby Week Council held in London on the 14th March 1934 Pp 25 (London National Baby Week Council)

The Board of Greenkeeping Research Report for 1933 Pp 38 (Bingley St Ives Research Station)

OTHER COUNTRIES

Canada Department of Mines Mines Branch The Mineral Industries of Canada, 1933 Compiled by A H A Robinson (No 738) Pp vii+116 (34 plates) (Ottawa King s Printer) 25 cents

Institut de France Académie des Sciences Annuaire pour 1934 Pp 405 (Paris Gauthier Villars et Cie)

Ministry of Finance Egypt Coastguards and Fisheries Service Fisheries Research Directorate Notes and Memoirs No 2 An Analysis of Arabian Seine Net Hauls on the Sea-coast near Ashtoum El Gameel, August 1928–May 1929 By R S Wimpenny Pp ii+113 (Cairo Government Press)

Madras Fisheries Department Administration Report for the Year 1932 33 By Dr B Sundara Raj Pp iii+74 (Madras Government Press) 10 annas

Year Book American Amaryllis Society Vol 1 In Memoriam Henry Nehrling 1853–1929 Pp 110 (Winter Park Fla W Hayward, Secretary 2240 Fairbanks Avenue)

U S Department of the Interior Geological Survey Bulletin 844 E Reconnaissance of the Northern Koyukuk Valley Alaska By Robert Marshall (Mineral Resources of Alaska 1931) Pp ii+247 256+plate 6 5 cents Bulletin 849–G The Girdwood District Alaska By C F Park Jr (Investigations in Alaska Railroad Belt 1931) Pp viii+381 424+plate 33 25 cents Circular 7 Gold Quartz Veins south of Libby Montana By Russell Gibson Pp 24 Circular 8 Beach Placers of the Oregon Coast By J T Pardee Pp 41 (Washington D C Government Printing Office)

Survey of India General Report 1933 from 1st October 1932 to 30th September 1933 Pp vi+75+11 plates (Calcutta Survey of India) 1 8 rupees 2*s* 6*d*

Report of the Aeronautical Research Institute, Tôkyô Imperial University No 104 On the Yield Points of Mild Steel Beams under Uniform Bending By Fujio Nakanishi Masaharu Itô and Kikuo Kitamura Pp 273 289 (Tôkyô Koseikai Publishing House) 20 sen

Field Museum of Natural History Report Series, Vol 10 No 1 Annual Report of the Director to the Board of Trustees for the Year 1933 (Publication 328) Pp 186 + 12 plates (Chicago Field Museum of Natural History) 1 dollar

Contributions from the Dudley Herbarium of Stanford University Vol 1, No 5 New Plants from Baja California by Ira J Wiggins New Western Erythroniums by Elmer I Applegate Two New Species in *Heuchera* and *Cuphea* by Rimo Bacigalupi Pp iv+161 193 (plates 11–17) (Stanford University Calif Stanford University Press) 1 dollar

Stanford University Publications University Series Biological Sciences Vol 2 No 5 Contributions toward a Monograph of the Sucking Lice Part 5 By Prof Gordon Floyd Ferris Pp 143 (Stanford University Calif Stanford University Press London Oxford University Press) 2 dollars

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CATALOGUES

Éditions Gauthier Villars Bulletin des Publications nouvelles (1er trimestre 1934) Pp 26 (Paris Gauthier-Villars.)

Catalogue of Lewis's Medical and Scientific Lending Library Second Supplement 1931–1933 Pp 112. (London H. K Lewis and Co , Ltd) 2*s* net.

A Catalogue of Books on British and Foreign Birds. (No 570) Pp 18 (London Francis Edwards, Ltd)

B D H Glucotest Outfit for the Rapid Determination of Sugar in Urine Pp 4 (London The British Drug Houses, Ltd)

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Pride and Prejudice in Africa

DESPITE the obligations which in common with France and the Union Government of South Africa Great Britain has incurred in accepting the trusteeship of some four millions of Africans under mandate from the League of Nations a rather vague pride in past achievements in suppressing the slave trade and a careless prejudice against any claims of the native races to be more than hewers of wood and drawers of water colour much of such public opinion as is from time to time called into existence by affairs in Kenya Colony and Tshekedi or similar incidents The situation is all the more deplorable in that during recent years there has been available a wealth of material which can assist the intelligent layman to pass accurate judgment on African affairs such as the reports of the East African Commission of 1924 under Mr W G A Ormsby Gore and of the Hilton Young Commission in 1929 Lord Lugard s studies of the principles of administration of backward races and so on

The most disturbing forces in the life of Africa at the present time arise from the insistent demand of the rest of the world for the products of tropical Africa This demand has set in motion economic forces which are producing revolutionary changes in vast areas where European settlement is impossible They are disintegrating the fabric of tribal life and creating problems of administration which cannot be left alone above all in the light of the calamitous experience of South Africa Apart altogether from the new standard of administration to which we are committed in Tanganyika Territory and which has been accepted as the standard of administration elsewhere in our African territories industrial conditions are poising problems which make a policy of *laissez faire* as dangerous from an economic point of view as it is morally indefensible

Of these problems the study of conditions in the copper belt of Northern Rhodesia with particular reference to the effect of the mines upon native society and upon the work of missions carried out in 1932 under the auspices of the Department of Social and Industrial Research of the International Missionary Council* provides many striking illustrations The copper belt of Northern Rhodesia was chosen as the chief field of study because its mines are among the latest that have been opened in Africa and they have been developed with a vigour and on a scale that have attracted a large native working population In addition the position of these mines between those of the Belgian Congo and the Union of South Africa with their widely contrasted labour policies gives Northern Rhodesia an opportunity to profit from the experience of its neighbours Many of the acutest difficulties in Africa to day are unfortunately the direct result of neglect sometimes deliberate of the lessons of history

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* Modern Industry and the African an Enquiry into the Effect of the Copper Mines of Central Africa upon Native Society and the Work of Christian Missions made under the auspices of the Department of Social and Industrial Research of the International Missionary Council By J Merle Davis Pp xviii+425 (London Macmillan and Co., Ltd 1933) 12s 6d net

This study makes it abundantly plain that the working of the copper mines is raising problems which go far beyond the immediate social and economic problems in the vicinity of the mines The withdrawal of labour from the native areas with a consequent shortage of man power for cultivation of essential food crops is threatening the whole economy of native life quite apart from the disintegrating influence of the new outlook and new needs acquired by natives working on the mines The structure of native society is being knit with our own in ways which it is now well nigh impossible to disentangle

It is of course clear that at the mines themselves problems of social welfare present an important field for scientific study and one in which co operation between the mines missions and Government is highly important Such co operation based on a careful study of the actual conditions might make a contribution to a better understanding between the natives and Europeans to the education of native society and the enrichment of the community at the mines and through it and through the network of native interests created to the foundation of an urban native society

Economic conditions present a particularly strong challenge Co operation of the type just visualised is fully as important in relation to the building of permanent communities round agriculture through the rotation of crops use of fertilisers soil conservation etc in place of the semi nomadic native methods which are inadequate to avert the continual threat of famine Much might be done by co operative methods to supplement the present training and experience of the native employed on the copper belt so as to increase his economic power on returning to rural life Agriculture in Africa to-day in all its aspects —technical social and economic—provides a field in which intensive scientific study is urgently needed and it is a sore reproach to the administration in Northern Rhodesia and elsewhere that funds for demonstration and experimental work under the Department of Agriculture have been cut to the bone

However just when science is affording growing support to the administration in its efforts to develop self government in accordance with native law and custom economic conditions and the impact of modern industry are strengthening the disturbing or opposing forces Discontent with the tribal system and its inadequate adaptation to the industrial revolution in Africa was a prime factor in the unrest which led to the Tshekedi incident An important paper by Dr R S Rattray at the Leicester meeting of the British Association directed attention to some of the doubts and misgivings regarding this system which are arising in spite of its promise for the preservation of the African national genius

The attack on the system of indirect rule comes partly from its tendency in the absence of adequate anthropological knowledge or experience on the part of those administrating it to build up centralised African autocracies out of harmony with African institutions and traditions It comes partly from the growing class of educated tribesmen who can find no place in a system which seems to discount Western education and Western lines of progress This element is being strongly and continuously reinforced by the wage earning class who have similarly been detribalised by their employment at the mines and have equal difficulty in finding a place in tribal society

These factors are shaking the existing system to its foundations There is widespread belief among the educated Africans which was encouraged by the reports of the Phelps Stokes commission that indirect rule and anthropology are veiled attempts to keep the African in his place Without the co operation of the educated native the whole structure of indirect rule must crumble and the fruits of anthropological research must be lost Only a determined attempt to develop an intelligent native leadership and a sound public opinion are likely to save the situation and here once again success will depend on adequate co-operation and harmony between industry missions and Government In each sphere there is need of fuller sympathy depending on accurate knowledge of native religious beliefs and old customs

The absence of that sympathy accounts directly for much native unrest as well as for recent mistakes in administration which have augmented such unrest Unrest is strongly reinforced moreover by the disproportion between the sums collected from natives and Europeans in taxation and the expenditure of those sums on social welfare and educational work among the natives From an industrial point of view the importance f sympathy and understanding of native customs and beliefs is already being recognised but the significant contribution of scientific work in these fields in establishing a relation of mutual confidence and respect is imperfectly apprehended by industry

From whichever aspect we survey them however African problems provide a surpassing field for scientific investigation and endeavour and the report before us indicates yet again some of the more important lines of work—the study of the various problems affecting public health whether in the mines or in the agricultural communities the improvement of the standard and quality of native agriculture both in respect of food and of economic crops provision of adequate transport in regard to the marketing of African produce and the mobility and efficiency of labour and the development of education so as to assist the native whether as a producer or as a wage earner to advance in the scale of civilisation and assimilate such moral controls as will enable him to resist the dangers and yet to utilise the advantages of increasing wealth

Here is a programme in which scientific work must play a decisive part but there is an even more important contribution which science may yet make In a brilliant criticism of the Rhodes lectures of General Smuts Mr J H Oldham has pointed out that just because Africa is only at the beginning of its development it may offer one of the most fruitful fields of experiment in regard to the place of expert knowledge in political affairs What is needed is a far sighted policy directed towards the economic development of the great resources of Africa on scientific lines in the interests of the native inhabitants the immigrant European and Indian communities and the world at large and at the same time promoting the physical intellectual moral and social advance of the African peoples Missions no less than Government and industry must have a clearly defined policy and there is no room in such a policy for prejudice

The new possibilities of service which science has opened up in dealing with the problems of dependencies are as yet largely unappreciated To urge that the scientific outlook and method should become an increasing factor in government is not to advocate the rule of a bureaucracy It offers much greater assurance that the human factors will be fully considered that account will be taken of the prejudices and beliefs of all parties and not merely of those of one section and that an honest attempt will be made to sort out the real cause of unrest The possibilities of mastery which science has given us in problems of government propound moral questions the answers to which depend on our scale of values and the application of scientific thought and method to African problems will in the e[illegible] be justified by the ability of science to keep those who use it loyal to the conceptions of disinterested service implicit in the spirit of science itself

The Complete Guide to Astrophysics

Handbuch der Astrophysik Herausgegeben von G Eberhard A Kohlschutter und H Ludendorff Band 1 *Grundlagen der Astrophysik* Teil 1 Pp xii+564 99 gold marks Band 2 Halfte 1 *Grundlagen der Astrophysik* Teil 2/1 Pp xi+430 69 gold marks Band 2 Hälfte 2 *Grundlagen der Astrophysik* Teil 2/2 Pp vii+431 752 57 20 gold marks Band 3 Halfte 1 *Grundlagen der Astrophysik* Teil 3/1 Pp x+474 77 gold marks Band 3 Halfte 2 *Grundlagen der Astrophysik* Teil 3/2 Pp viii+475–832 62 gold marks Band 4 *Das Sonnensystem* Pp viii+501 78 80 gold marks Band 5 Halfte 1 *Das Sternsystem* Teil 1/1 Pp x+574 99 gold marks Band 5 Halfte 2 *Das Sternsystem* Teil 1/2 Pp x+575–1156+2 plates 99 gold marks Band 6 *Das Sternsystem* Teil 2 Pp ix+474 68 70 gold marks (Berlin Julius Springer 1928–1933)

THE need for such a work of reference as is supplied by the Handbuch der Astrophysik has become growingly obvious as successive volumes have appeared The reviewer can speak from personal experience of its extreme usefulness in the observatory library and of its general completeness within its own scope as a work of reference The articles contained in the different volumes may be divided into three groups—the theoretical the instrumental or optical and the observational It must not however be supposed that there is any rigid division between these groups The articles necessarily and rightly overlap Thus an instrumental article on photometry quite properly has special reference to the astronomical applications and may well trench upon the domain of the article on the luminosities and colours of the stars The fact that the two overlapping articles approach the same subject from two different points of view may lead to slight confusion here and there but is probably more of a help than a hindrance to the student of the subject

The theoretical articles may be subdivided into two sets one of which belongs rather to the domain of pure physics though headed in the direction of astrophysics and to some extent limited to the requirements of the astrophysicist such articles as those on optical theory theoretical photometry radiation the principles of the quantum theory laws in series spectra multiplet spectra and band spectra all come under this head The more astronomical articles of a theoretical type are those on the thermodynamics of stars the theory of pulsating stars and the ionisation of stellar atmospheres In these articles gaps in the existing literature on stellar atmospheres are well filled in up to the date when the articles were written

The optical or instrumental articles include an account of the construction and testing of telescopes and a discussion of the problems of practical spectroscopy Full details are given of the instruments used and of the methods to be employed in astrophysical work in photographic and photoelectric photometry also in visual photometry spectrophotometry and colorimetry Special attention is paid to work on solar radiation The reduction of photographic plates is a subject that one might scarcely expect to find in an astrophysical Handbuch but its presence as a separate article indicates how widely the editors have cast their net

The third group of articles deals with the results of observation and gathers together a great wealth of scattered data often difficult of access They give in general a very readable if at times somewhat uncritical account of the special subjects under discussion Naturally a wide range of topics calls for mention stellar spectroscopy (classification and radial velocities) variable stars novæ binary stars (visual and spectroscopic) solar radiation solar physics eclipses comets and meteors photometry of planets stellar photometry stellar temperatures stellar luminosities and masses nebulæ the Milky Way, stellar clusters and stellar statistics are among the subjects treated in separate articles of very varying length It will give an idea of the general scale of the work to mention that in the article on variable stars 74 pages are devoted to stars of the Mira Ceti class and 41 pages to Cepheids

The articles are written in English or German at the choice of the various authors Half of the thirty three contributors are German but articles have been contributed from eight other countries the whole work may be regarded as one more example of that international co operation which has always been so valuable in the world of astronomy The appearance of successive volumes has extended over a period of five years This is reflected in two ways on one hand where theory has been rapidly developing as in the quantum theory or the study of stellar atmospheres it is almost possible to date the articles by the outlook they represent and different articles may approach the same question from very diverse viewpoints on the other hand where fresh observations have been accumulating as in the study of line contours and intensities there are already obvious gaps in those articles which were published several years ago It is a pity for the sake of their use as sources of reference that the articles are not dated but a supplementary volume is intended and that may remove this difficulty It will be a great help if the supplementary volume could contain a complete subject index for all ten volumes at present it is not as easy as it might be to trace a subject back to the one or two overlapping articles in which it is discussed or to find exactly where a subject is treated on the particular side in which a reader may be for the moment most interested

With regard to the form of publication of the volumes we may note that the printing is clear and very readable this including the numerous valuable tables the text is also very free from misprints Illustrations are lavish and well reproduced—perhaps the article on solar physics is best served in this particular For volumes that are likely to be well used the binding is not as good as it might be and the lettering on the backs is liable to be somewhat easily obliterated

Passing from the general to the particular it is impossible within the limited range of a short review to discuss seriously 36 articles extending over 4 000 pages but it may be possible to give an indication of their character by selecting a few, frankly recognising that they represent a purely personal choice on the part of the reviewer Prof Abetti in his well illustrated article on solar physics discusses solar spectrographic instruments of various types visual photographic and spectroscopic observations of the sun s surface and the deduced results also theories of the constitution of the sun Dr Graff in his discussion of the planets examines the evidence as to their atmospheres rotations spectra and such allied questions as the nature of the zodiacal light Prof H D Curtis in his article on the nebulæ discusses the different types—diffuse planetary and spiral—with the various theories as to their origin and structure—also such closely allied questions as the expanding universe useful bibliographical information is added Under variable stars Prof Ludendorff classifies the various types showing the links between them and gives a full account of the literature and of the many theories put forward especially with regard to the Cepheid variables The subject of pulsating stars is discussed mathematically in a separate article by Prof F A Milne whose article on the thermodynamics of the stars comes naturally alongside one by Prof A Pannekoek on the ionisation in the atmospheres of the stars

Linking these theoretical articles to observational astronomy with due emphasis on the difficulties underlying work in this sphere comes the article by Prof Brill on spectrophotometry A discussion of sources of error in dealing with the continuous spectrum and line intensities makes clear that existing discrepancies between theory and observation may still be in part due to difficulties in the observational side In this connexion one may express the hope that in the supplementary volume some attention will be paid in any additions to the articles on multiplet spectra and band spectra to the astrophysical interest of the subject The articles by Prof Laporte and Dr Wurm respectively though useful and complete partake rather of the nature of textbooks on the subject and are not obviously what might be expected in a volume of primarily astrophysical interest

In conclusion a word of gratitude is due to the editors of the Handbuch for the laborious task that they have undertaken and carried through so successfully They have placed all workers in the subject under a heavy debt and they have gathered together within easy reach much information that may be valuable to those researching in allied fields

F J M STRATTON

Himalayan Poppies

An Account of the Genus Meconopsis By George Taylor With Notes on the Cultivation of the Introduced Species by E H M Cox Pp xiii+130+29 plates (London New Flora and Silva Ltd 1934) 20s net

THE Natural History Museum is happy in possessing a band of young field botanists who bid fair to bring botanical science lately overshadowed by the romantic march of the physical sciences once more into high repute Of this band Mr Taylor is not the least *Meconopsis* is one of those select genera dear to horticulturists But for them it might long have languished in darkness unhonoured and unsung British horticulturists have stimulated discovery cultivation and study and Mr Taylor with a wealth of material living and dead before him collected primarily in the interests of horticulture has presented them with a new classification and brought our knowledge of the genus up to date

It is however botanists rather than horticulturists who will be interested in what Mr Taylor has to say The author has a wide acquaintance with his subject and is both lucid and provocative he is not the worse botanist for that Old mistakes are resolved tangles untangled new ideas infused It would be no compliment to say that all taxonomists will accept his rearrangement of the genus but his opponents will need to be well equipped before joining issue with him

Mr Taylor takes up the position that species are distinguished by fixed morphological characters not connected by intermediate forms conversely if there are intermediate forms they embrace one (Linnæan) species no matter how extreme the divergence He has applied this principle ruthlessly to *Meconopsis* other taxonomists have not applied it to for example *Rhododendron* There seems to be no relationship between the age of a genus and its degree of stabilisation and *Meconopsis* is not more polymorphic than *Rhododendron* Stabilisation is probably more a function of space than of time Cytology may help in the delimitation of species but as Bruun has insisted in his Cytological Studies in Primula (Uppsala 1931) chromosome differences constitute only *one* character comparable to a morphological character though perhaps more fundamental Nevertheless the results are sometimes surprisingly at variance with visible differentiation for example in section

Sikkimensis of the genus *Primula* Mr Taylor faces the difficulty boldly, and takes his own line He may be right in attaching more importance to stylar than to epidermal structures, though both are probably artificial in the sense that we cannot link them to any function, or trace their evolution Indeed the author expressly denies any relationship between his subgenus *Discogyne* and *Papaver* Then, when he comes to *Meconopsis integrifolia*, he waxes a little impatient over the synonymy, based on styles, and helps the lame dogs over theirs with a flying leap Nor is he quite consistent, since he advances the same argument for unity here that he advocates for separation between *M venusta* and *M impedita* It is surprising, too to find him upholding, even provisionally, *M argemonantha* on the woefully imperfect material available The fate of *M Baileyi* should have warned him

No really satisfactory system of representing distribution has yet been devised To enclose all recorded areas for a taxonomic unit has its uses, but the method is apt to obscure more than it reveals Some adaptation of the layer system might be employed Mr Taylor gives us several maps, but we are left with an empty feeling that they convey no more than meets the eye We should have preferred distribution maps of the more comprehensive species, such as *M horridula* and *M impedita*, especially in combination with larger taxonomic units The statement (p 94) that "all forms [of *M horridula*] may be found growing in association in the field" is surprising, though its correct interpretation depends upon the scope of "in association" The reviewer's experience is that *all* varieties, even colour varieties, of *Meconopsis* definitely tend to segregate Again, the statement (p 33) on the authority of a collector, that *M superba* grows "above the snow line" is equally surprising—if true

Mr Taylor does not mention latex, though the colour of this is sometimes a useful diagnostic character Nor does he mention that the seeds of *M betonicifolia* are eaten by the natives in lieu of *Papaver somniferum*, and so may be assumed to possess narcotic properties

But the mantle of Sir David Prain, whose last revision of the genus was published nearly twenty years ago, has fallen on worthy shoulders At the prohibitive price, the format might have been better Some of the photographs are excellent, we should have preferred some line drawings of capsules, in the text, for others

Social Values

The Conflict of Values By J R Bellerby (Published by Education Services) Pp xi+204 (London Richard Clay and Sons, Ltd, 1933) 6s net

AN encouraging sign of the times is the clearer recognition of the need for experiment in economics and sociology The difficulties in the way of practical work in this field are of course sufficiently obvious, but they are surely not insuperable, and the need for overcoming them was never greater than now

As Mr Bellerby shows in his new book, the first step for a nation as for an individual is to have some definite aim and purpose, an architect's plan an ideal State shining as a star ahead, never actually attainable, but inspiring our best efforts in the search for real values This would appear to be the first law both in individual and social psychology Mr Bellerby endeavours in a philosophical discussion, somewhat after the Platonic manner, to discover these values, combine them into a complex 'web of purpose', and relate them to an economic or industrial structure leading as nearly as possible in the direction of the ideal state He brings to his task a highly interesting and attractive style, original and courageous thought, and above all a keen sense of practical difficulties as illustrated by actual test and experiment

The book is a sequel to a previous work entitled "A Contributive Society", and, in the author's own words, is ' the logical completion of that work, giving point to its main theme by describing the life values, or the scheme of values, which may be achieved through contribution"

This first chapter marks the end of the first phase of theory, after which the experiment is described, from which useful criticisms have been drawn The attempt is made to illustrate a 'contributive' society, in contrast apparently with Mr Tawney's 'acquisitive' society Inspired by a new estimate of life values, which, however, in themselves are not new since they go back to Plato and Christ, the members of this social group endeavour to contribute a maximum both of service and worldly goods or money to the common fund, on the principle of the 'average wage' The group is established on a purely voluntary basis, without compulsion of any sort, and the life values which are re stated in relation to modern economics are those concerned with beauty, truth (or knowledge), and love For the individual the aim is to develop personality to the utmost, and in doing this in the right way the greatest advance will be made towards attaining the ideal State or community

This question of values in social philosophy has exercised the greatest minds in all ages, and has led to visions of many Utopias, those of Plato, More, Morris, Bacon, and others, most of them being here briefly outlined and discussed by Mr Bellerby, including a note on the inner meaning and implications of progress, and the contrasts between the Western mind of breathless activity and the Oriental mind of calm meditation The theory of social evolution is apparently accepted by the author, but this somewhat complicates matters, tending as it must do to a fatalistic outlook, especially if one goes so far as Keller and Sumner (in ' Societal Evolution"), wherein there is not necessarily any progress, and human destiny is determined by the operation of blind, impersonal, yet invincible forces

The 'web of purpose', and the setting up of an economic system must before all things be purposive, and contribute to the development of personality "Its processes must be such as to challenge and demand character, and its product must aid men to strong growth" This view of one of the aims of industry has already been outlined in the columns of NATURE by the present reviewer, as also was another important point, referred to by Mr Bellerby as the central problem of his book This is the question of what best constitutes the 'web of purpose' and ideal to be aimed at Is it the militaristic ideal of the Vikings, the bustling activity and obsession for business of the western nations of Europe, the meditative philosophy of the Oriental, or religious piety, or scientific attainment ? The answer given long ago, and now given again by Mr Bellerby in almost the same words, is that the ideal State, embodying the ideal industrial system, so far as this is conceivable, will not be one fixed or static and stereotyped system, based on one single ideal, like that of large scale mechanised industry for example (if this is really an ideal) Certainly it does seem that this is the inevitable outcome of present tendencies, but these tendencies are not necessarily right or inevitable, especially when viewed in the light of a philosophical analysis of values

Mr Bellerby particularly emphasises the need, as has already been done before in these columns, for elasticity and variety, for both breadth and depth, in the contributive society, so that not one ideal only but probably many ideals may find inspiration and scope So far as the industrial structure is concerned, it was long ago pointed out by some of us that room should be found for many different forms of industry, both large scale and small, both mechanised and handicraft, competitive and co operative, individualistic and communal That there may be incompatibility and even conflict between the various ideals is realised by Mr Bellerby in the very title of his book, but this need not deter the far sighted statesman and an intelligent and educated people from attempting a nice balance between all the various elements which should go to make up a great industrial and agricultural nation

W G L C.

Short Reviews

Muller Pouillets Lehrbuch der Physik Elfte Auflage Herausgegeben von A Eucken, O Lummer und E Waetzmann In 5 Banden Band 4 *Elektrizität und Magnetismus* Teil 4 *Elektrische Eigenschaften der Metalle und Elektrolyte, magnetische Eigenschaften der Materie* Herausgegeben von Arnold Eucken Pp xx + 906 (Braunschweig Friedr Vieweg und Sohn A G, 1934) 62 gold marks

THERE is no doubt that this final portion of the fourth volume of the eleventh edition of such a well-known treatise on physics is bound to be of interest to all who teach modern physics or who are interested in research on the conduction of electricity by solids and liquids The book gives an excellent treatment of the experimental aspects of the electrical properties of metals, including an important section on thermo-electric effects It also includes an adequate discussion of thermionic phenomena, and a very satisfactory statement of modern statistical and kinetic theory of the metallic state is contributed by Nordheim

Coehn of Göttingen is responsible for the account of electrolytic processes, including an important section on the modern theory of strong electrolytes, while Jost of Hanover appends an account of the electrical conductivity of non-metallic crystals O v Auwers, whose recent work on hysteresis cycles of the perminvars aroused much interest, gives a very concise treatment of magnetic phenomena, and a survey of the quantum theory of magnetism, by Nordheim, completes a very fine work

It is almost unnecessary to add that the standard of the production is in all respects equal to that of the first three parts of the volume

Meteorology for Masters and Mates By Charles H Brown Seventh edition Pp ix+234 (Glasgow Brown Son and Ferguson Ltd 1933) 7s 6d net

THE object of this book appears to be mainly to assist those taking the master s and mate s examination to answer questions in meteorology which demand a greater knowledge than seems to be required according to regulations It should however also help to stimulate interest in the subject and assist in producing a generation of seamen able to take full advantage of the help in navigation that can be obtained from the exchange by wireless of weather information between ships at sea and shore stations The author goes more into the physical causes underlying meteorological phenomena than he did in the earlier editions of the same work From the point of view of the examinee the arrangement of the subject matter appears excellent the syllabus for the first mate s as well as for the master s examination is given at the beginning and examination papers are set at the end with references to the parts of the work dealing with the subject matter of each question

Under Velocity of Gales (p 86) it is stated that It is to be understood that the direction and force of the wind depends on the part of the depression that the observer is situated in but that the speed of a gale is really the rate of travel of the system which has the implication that a gale never occurs in a stationary depression On the same page there is the further statement that the force and frequency of the squalls of wind depend not on the gradient alone but also on the distance from the centre of low pressure It would be interesting to know what evidence there is in support of this statement E V N

Santiago de los Caballeros de Guatemala By Dorothy H Popenoe Pp xvi+74+7 plates (Cambridge Mass Harvard University Press London Oxford University Press 1933) 6s 6d net

THE Spanish city well described and illustrated in this volume was begun towards the middle of the sixteenth century as the third capital of the colony of Guatemala after the second one Almolonga built by Alvarado had been destroyed by earthquake Much of the city known to day as Antigua Guatemala still stands but it lies in a volcanic area and suffered repeated earthquake shocks until in 1773 it was so badly devastated that Spain ordered its abandonment and the removal of the capital to a new site the modern Nueva Guatemala Mrs Popenoe had made a wide study of Central American archæology and written this book shortly before her untimely death She has succeeded in reconstructing the life of the city and much of the beautiful architecture of the early Renaissance which characterised the first buildings The work is based on old documentary records

Kohlensäure und Kalk Einführung in das Verständnis ihres Verhaltens in den Binnengewässern Von Prof Dr Julius Pia (Die Binnengewässer Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten herausgegeben von Prof Dr August Thienemann Band 13) Pp vii+183+3 plates (Stuttgart E Schweizerbart sche Verlagsbuchhandlung (Erwin Nägele) G m b H 1933) 21 gold marks

THE present volume of Die Binnengewässer is a treatise on carbonic acid and chalk in fresh waters It is a comprehensive work and like all the previous parts covers much ground and the subject is considered from many different aspects The three parts into which it is divided deal respectively with chemical constants and theories of solubility in organic and organic precipitation and the most important chalk deposits Compared with the condition in the sea the part played by living organisms in connexion with the precipitation of chalk is small the various chemical and physical factors are much more important in fresh waters The research of the various specialists in these subjects is fully described and there is a bibliography of 26 pages making this volume a most satisfactory work of reference

La France méditerranéenne Par Prof Jules Sion (Collection Armand Colin Section de géographie No 164) Pp 222 (Paris Armand Colin 1934) 10 50 francs

PROBABLY no region of France has more distinctive physical conditions and human characteristics than the Mediterranean border The difficulty in discussing this region lies in fixing its limits Prof Sion has wisely confined his attention to the plains the delta of the Rhone and the coastal ranges of hills After briefly explaining the structure he goes on to discuss human relationships historical economic and demographic tracing with a sure knowledge the reasons for the various changes that the region has undergone of which none is more interesting than the decline of wheat and the development of viticulture and the rise of the various seaports No student of geography can afford to miss this important though small work on the geography of France R N R B

Plant Life Through the Ages a Geological and Botanical Retrospect By Prof A C Seward Second edition Pp xxi+603 (Cambridge At the University Press 1933) 30s net

IT is unnecessary to emphasise the authoritative nature of this geological and botanical retrospect the name of the author who is professor of botany in the University of Cambridge carries sufficient guarantee The fact that within two years a second edition of a specialised work has been called for speaks well for its success The first edition was reviewed at length in NATURE of October 3 1931, p 559 A few alterations and corrections have been made and more references added in the present edition

Twenty One Years of Fruit Research at East Malling

THE Fruit Research Station at East Malling, in the heart of the Kent fruit area, which was established in 1913, at the request and with the active and continued assistance of fruit growers, celebrates its coming of age at the annual meeting of its supporters on May 24 The occasion is being graced by the presence of His Royal Highness the Duke of York, who has consented to honour the Station by visiting its plantations and laboratories on that date when the Institute's subscribing members, now numbering 1,000 will have their annual opportunity of making a closer acquaintance with the results of the experimental work, special demonstrations of which will be staged

A prime essential for the successful prosecution of research on fruit plants is continuity of policy If more than fragmentary information is to be obtained experiments must cover a reasonable proportion of the useful life of the subject, so that an investigation even of strawberries may last four or five seasons, whilst the full value of trials of tree fruits may not be obtained in less than twenty years

Since 1913, in spite of the necessary restriction of its activities during the War years, the Station by adherence to a clear cut programme of long distance research in the field and in the laboratory, has obtained results of fundamental importance to fruit growers The annual total of 2 000 interested inquirers who visit the Station is an indication of the confidence placed in its work by the industry, which recognises that the best fruit must be grown before the best marketing methods can be applied

Important contributions have been made to the practice of the culture of small fruits such as black currants and raspberries, first by systematic botanical studies of varieties, which made possible accurate identification and consequently the accumulation and maintenance of races and strains true to type Only when this had been effected was it possible to begin field trials to determine the cropping capacity, manurial requirements, disease resistance and market value of the multitude of varieties available in commerce Such investigations, coupled with the elaboration of methods of control of pests and diseases, have been the main factor in lifting black currant culture from a haphazard gamble to its present condition of an organised system of operations which can be undertaken with a reasonable certainty of success

Similar methods, linked up with the evolution of a scheme of nursery hygiene, have been applied to raspberry growing, and a large measure of success has already been obtained, whilst problems of the propagation and control of diseases and pests of the strawberry, loganberry and blackberry are under investigation

Fruits such as apples, pears, plums and cherries, the trees of which are budded or grafted on root systems other than their own, present problems similar to those of the small fruits, but, in addition, further complications are introduced by the presence of the foreign root system The first step was the collection of examples of these rootstocks from a wide range of commercial sources, and after meticulous botanical examination it was possible to construct a very necessary system of classification for identification purposes and to avoid future confusion The next stage was the multiplication of the different rootstock types and for this purpose vegetative methods were resorted to in order to preserve to each its own genetic constitution This process alone involved a prolonged intensive investigation since many varieties did not propagate easily and special methods had to be evolved to apply to different cases Trials have been made with hardwood and softwood cuttings, root cuttings layers and stools, and thus was found the most suitable method for each variety The next process was the raising of series of trees of commercial scion varieties budded or grafted on each type of rootstock, and these were then planted out grown under a recognised commercial system of culture and intensive records of individual tree performance were taken over several years The records include annual measurements of the total length of new shoots the girth of the trunk, the height and spread of the branches, leaf area the number of blossom trusses formed and the number size, colour and quality of fruits

In parallel with field trials of this type, experiments have been carried out in which similar trees are subjected to different degrees of winter stem pruning, the effect on subsequent performance being measured by a series of routine records as in the rootstock trials

Manurial investigations have been conducted, both in the field and in pot culture, and valuable information relative to this subject has also been obtained by work on the spatial distribution and time of growth of roots A number of trees up to ten years old on different soils have been excavated piecemeal and then reconstructed, giving a picture of the spread and depth of the roots to which manurial substances have to be supplied The time and rate of root growth are determined by direct measurement of growing roots through glass windows in the sides of underground observation posts

These and other converging lines of research have now made it possible to classify the rootstocks on the basis of the influence which they exert on the scion, and the trees growing in the plantations of the institute, each coupled with its own particular record of past performance, demonstrate the fundamental importance of using standardised rootstocks, chosen with full regard for their potentialitites, which are now known with considerable accuracy

It has of course long been known vaguely that the rootstock has some influence on the performance of a tree but the accumulated results of the Station s experiments have shown just what this influence may achieve and how advantage may be taken of it though it is not yet clear what physiological and chemical mechanism is involved in the translation of rootstock potentialities into scion performance It is however now certain that choice of rootstock may mean the difference between the economic success and failure of a plantation since such factors as the vigour and disease resistance of the tree the age at which fruit production begins the amount of crop and the size colour and quality of the fruit may all be affected by the rootstock

Some control of these factors may of course be achieved by such cultural treatments as pruning and manuring but since tree fruit plantations are planned in relation to a future of 30–50 years the importance of obtaining control of the trees by selecting at the outset the correct rootstock in relation to its purpose need scarcely be emphasised The extent of this control is such that it is now possible by rootstock selection to choose in advance whether a tree shall become a dwarf bush for the garden or a large standard with a spread of 40 ft and in fact to produce at will trees suitable each for its particular purpose

The natural corollary of these investigations was not only to make them known to the fruit growing industry but also to make available the material with the aid of which the principles could be applied Consequently in order to ensure that growers and nurserymen shall be able to procure in quantity suitable rootstocks and desirable and healthy varieties of small fruits all true to type the Station has established a considerable acreage of nurseries where material is raised and distributed through commercial sources The number of plants thus made available now amounts to 250 000 annually The area now under experiments amounts to 130 acres and in the course of the investigations problems have arisen which have necessitated co operation of pomologists physiologists mycologists bacteriologists entomologists statisticians and chemists their publications appear in the Station s Annual Reports and in biological journals chiefly the *Journal of Pomology and Horticultural Science*

The Imperial Bureau of Fruit Production founded in 1929 is housed at the Station and acts as a clearing house of information concerning research on fruit plants which is made available through *Horticultural Abstracts*

Canadian Water Power Developments during 1933

By Dr Brysson Cunningham

THE recent issue by the Dominion Water Power and Hydrometric Bureau of the Canadian Department of the Interior of two reports relating to hydro electric developments during the year 1933 enables a fresh survey to be made of the remarkable progress which continues to be achieved in the Dominion in the exploitation of its natural water power resources

It was scarcely to be expected that the rate of development which from 1924 until the end of 1932 was fairly constant at the high figure of nearly 440 000 additional horse power per annum could be maintained during the present period of economic depression In the circumstances it is satisfactory to record that the net increase during 1933 was no less than 270 210 horse power bringing (with a previously untabled item of 16 600 horse power in 1932) the total development at the beginning of this year up to 7 332 070 It is conservatively estimated that this represents a capital investment of 1 675 000 000 dollars and that it is capable of effecting a saving of about 36 000 000 tons of coal per annum The actual saving for the year 1933 is computed at 14 775 000 tons As projects require several years to materialise the annual increment of power is of course mainly due to installations the inception of which dates back a corresponding period During 1934 and thereafter there will be further increments on the completion of undertakings now under way but from the point of view of the maintenance of the rate of progress it is significant and unfortunate that no undertakings of magnitude were initiated during 1933

The distribution of the present realised total of 7 332 070 horse power among the various provinces of the Dominion is shown in the accompanying table which also exhibits a statement of the estimated total power available It would not be correct however to deduct the realised horse power in column 4 from either of the totals of available power in columns 2 and 3 for the purpose of arriving at the balance still awaiting development because experience in the matter of turbine

AVAILABLE AND DEVELOPED WATER POWER IN CANADA
January 1 1934

Province	Available 24 hour power at 80 per cent Efficiency		Turbine Installation (h p)
	At Ordinary Min Flow (h p)	At Ordinary Six Months Flow (h p)	
British Columbia	1 931 000	5 103 500	717 602
Alberta	390 000	1 049 500	71 597
Saskatchewan	542 000	1 082 000	42 035
Manitoba	3 309 000	5 344 500	390 925
Ontario	5 330 000	6 940 000	2 355 105
Quebec	8 459 000	13 064 000	3 493 320
New Brunswick	68 600	169 100	133 681
Nova Scotia	20 800	128 900	112,167
Prince Edward Island	3 000	5 300	2 439
Yukon and Northwest Terr	294 000	731 000	13 199
Total	20 347 400	33 617 200	7 332 070

installation demonstrates the realisation of an excess of some 30 per cent over the ordinary six months' flow power On this basis, it is a legitimate conclusion that the recorded water power resources of the Dominion will permit of a turbine installation of about 43,700,000 horse power, of which the present realised total is rather less than 17 per cent Even so, the per capita development for the Dominion, namely, 686 horse power per 1,000 of the population, places Canada in an outstanding position among countries of the world using water power

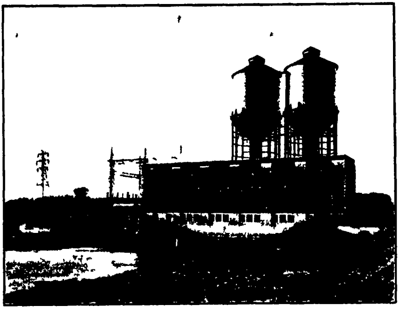

FIG 1 Masson Development Lievre River Quebec, 136 000 h p of the MacLaren Quebec Power Company By courtesy of the Dominion Water Power and Hydrometric Bureau Ottawa

Of the 270 210 horse power brought into operation during 1933, rather more than a moiety (136,000 horse power) is due to the completion of the Masson Development of the MacLaren Quebec Company, situated at the mouth of the Lievre River in Quebec Province, of which a view is given in Fig 1 It comprises four turbine units, each of 34,000 horse power and has a dam and intake 1,050 ft long with a tunnel 6,060 ft long leading to the power house There is an effective head of 185 ft

Another important enterprise, now in hand, is the Canyon Development on the Lower Abitibi River in Ontario, which has been acquired by, the Provincial Government and its operation placed in the hands of the Hydro-electric Power Commission of Ontario Ultimately, the installation will comprise five turbine units of 66,000 horse power each Two of these are complete and in operation, the first having been put into commission in May 1933 and the second in August last A cable line at a voltage of 132,000 transmits current from the Canyon to the Sudbury mining district, 246 miles distant Under an agreement recently concluded between the Hydro electric Power Commission and the Canadian Northern Power Corporation, current from the Canyon will be an important factor in mining development in Northern Ontario

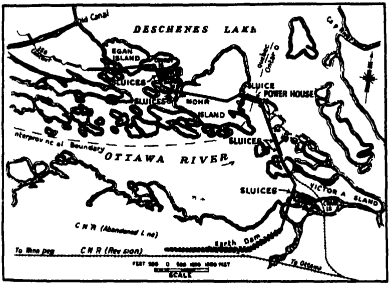

FIG 2. Site plan of the Chats Falls Development

The Beauharnois installation, described in NATURE of June 3, 1933, continues to expand During 1933, contracts were placed for the balance of the equipment (turbines, generators, transformers and switching equipment) necessary to produce the full 500,000 horse power development, and this is expected to be realised in 1936 The present capacity is 133,000 horse power, exclusive of that required for constructional purposes

Although not coming precisely within the limits of the period under review, the Chats Falls Development[1], completed in September 1932, is an undertaking the magnitude of which merits some notice, and, moreover, apart from its outstanding capacity of nearly a quarter of a million horse power, it is the first major power development in the inter-provincial section of the Ottawa River which constitutes a complete exploitation of the whole flow at any site The Ottawa River is the boundary between the Provinces of Ontario and Quebec for a length of 300 miles from Lake Timiskaming to Carillon, a point 25 miles from the junction with the St Lawrence Favourably for the important pulp and paper factories established along its banks, it affords a number of valuable sites for hydro electric power development such as those at Quinze (40,000 horse power), Bryson (25,000 horse power) and Ottawa As will be seen in the plan of the locality (Fig 2) the portion of the river developed at Chats Falls lies between Chats Lake and Lake Deschenes These lakes are really broadened expanses of the river and they have areas of 27 and 36 square miles respectively Uniting them is a channel about 3 miles in length, in which there is a natural fall of about 50 ft, 38 ft of which are in the falls proper at the lower end of the channel and the remainder in the rapids above the falls The rapids and the falls are separated by a sheet of water, one square mile in area, known as the Fishery Pool, and this forms the forebay of the development From records taken over a period of seventeen years, it has been ascertained that the mean flow at Chats Falls is 45,000 cusecs, with a dependable minimum of 22,000 cusecs, which by the enlargement of certain storage facilities on the main stream and its tributaries is susceptible of an increase to 28,000 cusecs

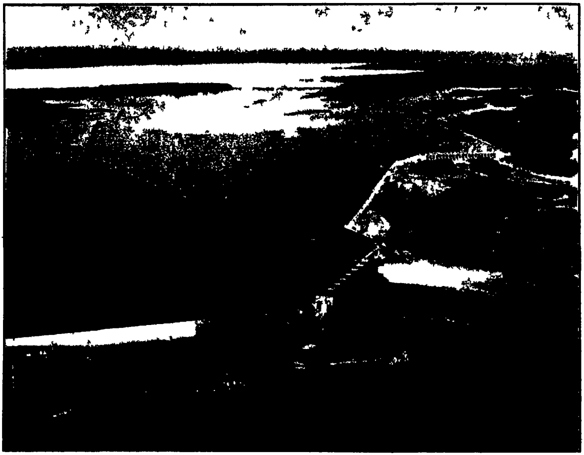

FIG 3 Chats Falls Development 224 000 h p of the Hydro-Electric Power Commission of Ontario and the Ottawa Valley Power Company
By courtesy of the Chats Falls Engineering Board

The present hydraulic installation consists of eight turbines each with a rated capacity of 28,000 horse power under a head of 53 ft and at a speed of 125 rev per minute The operating head varies from 38 ft at times of very high river flow to 58 ft at low flows The photographic view reproduced in Fig 3 which has been courteously supplied by Dr Hogg, chairman of the Chats Falls Engineering Board, shows the power house and forebay with part of the adjacent constructional works, the latter being more completely indicated on the plan (Fig 2) To the left of the power house (in the photograph), on the Ontario shore there are, in turn, a gravity dam some 1,200 ft in length, 32 sluices, known as the Ragged Chute sluices, each with a clear opening of 18 ft, a gravity dam, 1,350 ft long the Victoria sluices, 10 in number, also with 18 ft openings, and a further gravity dam of 1,450 ft length Beyond this, there is a low earthen dyke, or embankment, parallel with the river edge, extending for nearly a mile upstream On account of these works, a section of the Canadian Railway, two miles in length, had to be re-laid farther inshore On the Quebec, or western side, immediately adjacent to the power house are 4 sluices, each 40 ft in width, and a log slide , then a gravity dam, 2,000 ft long , the 10 Wolverine sluices , another dam, 650 ft long , 22 Merrill Island sluices and, finally, a dam, 2,600 ft long, terminating in a number of short disconnected lengths closing low-lying areas Alongside the power house, in the foreground of Fig 3, can be seen the transformer station, consisting of 13 single phase transformers, 13 2 kv to 220 kv , while 800 ft farther along is the 220 kv switching station occupying an area of about 300 ft by 360 ft

Not the least important feature of hydro electrical exploitation on a national or provincial scale is the regulation of water supplies, and in this connexion the work of the Quebec Streams Commission is worthy of notice The Commission continues to maintain with every success the desired regulation of flow on all the controlled rivers through its extensive system of storage reservoirs in various parts of the province It controls seventeen reservoirs, five of which are on the St Maurice River two on the St François River, two on the Gatineau River, one at Lake Kenogami for the Sable and Chicoutimi Rivers , three on the North River (Lakes Masson, Long and Bedini) , two on the St Anne de Beaupré River (Lakes Brulé and Savane) , one on Mitis River and one on Rivière du Lievre The Commission has also proceeded with the further investigation of storage problems on the Upper Ottawa River, including Jourdan Lake Numerous lakes have been examined to determine whether they are to be considered as navigable waters, and river profiles have been taken Studies of ice formation have been made and also sundry investigations of back water and drainage, besides the execution of bank protection work

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[1] Hydro-electric Progress in 1933 By the Hon Thos G Murphy, Minister of the Interior Ottawa Water Power Resources of Canada' Paper No 1733 Dominion Water Power and Hydrometric Bureau Ottawa

[2] The Chats Falls Development Papers by various writers, reprinted from the *Engineering Journal Canada* February and March 1933

World Climate during the Quaternary Period

AT the Royal Meteorological Society on May 16 Dr G C Simpson read an important paper on his theory of the climatic variations during the Quaternary Ice Age, with especial reference to its geological implications Briefly, the theory states that the effect of an increase in the solar radiation intercepted by the earth is a relatively small increase in the earth's temperature, but a large increase in the evaporation, cloudiness and precipitation In high latitudes or on high mountains, where the precipitation is mainly in the form of snow, the first result is an extension of the ice sheets and glaciers, but as the radiation increases still further, the rise of temperature becomes great enough to melt away the ice If the solar radiation, starting from a minimum, goes through two complete cycles, the climatic succession would be cold dry climate , glacial , warm wet interglacial , glacial , cold dry interglacial , glacial , warm wet interglacial , glacial , cold dry climate Hence there would be four glacial periods separated by three interglacials, of which only the first and third would actually be warm In low latitudes, on the other hand, the two cycles of radiation would be represented only by two pluvial periods separated by an interpluvial, the maximum of each pluvial coinciding with a warm wet interglacial

The physical basis of the theory offers no difficulty, requiring only that the earth shall fluctuate in the unstable zone between insufficient snowfall and too great heat The real test is whether the theory fits the geological facts, and in his latest paper Dr Simpson arrays an impressive mass of evidence that the fit is very good indeed Two primary difficulties are first attacked , the centre of glaciation in the northern hemisphere was not the north pole, but lay somewhere in Greenland, while careful analysis by Penck and Brückner has shown that, in the Alps, glaciation was not due to increased snowfall but to decreased temperature Both these difficulties are explained by the geographical fact that the North Atlantic is open to the Arctic, while the North Pacific is not During the oncoming of a glacial period there was a great accumulation of floating ice in the Arctic Ocean, and the only outlet through which this could escape led into the Atlantic, which was covered by ice floes down to comparatively low latitudes, while the Pacific was ice free This floating ice greatly lowered the temperature of eastern North America and still more of western Europe, and led to the great extension of glaciation in countries bordering on the Atlantic In the early stages of the Quaternary, however, communication between the Arctic and Atlantic was more or less interrupted by a bar between Greenland and Norway or Scotland , until this bar was submerged, glaciation was unable to develop over the British Isles

In another respect the classical work of Penck and Brückner in the Alps fits the theory very closely, giving exactly the required sequence of four glacial periods and three interglacials, of which the second was known to be very long compared with the third, while the latter was exceedingly wet and warm The theory is supported also by recent discoveries in tropical Africa of two great pluvial periods separated by a very dry interpluvial Archæologically, the third interglacial is dated in Europe by the Acheulean, which is everywhere associated with a warm fauna From the geological record, Dr Simpson estimates that at the maximum of the solar radiation the temperature was between 5° C and 10° C higher than at present and the cloud amount about two tenths greater from these data he calculated that the sun is a variable star with a range of 40 per cent in the intensity of its radiation

Since the chief purpose of the paper was the array of geological evidence in support of the theory, the discussion was mainly carried on by the geologists The present writer gained the impression that the latter accepted the general implications of the theory but found considerable difficulty in agreeing to the details On one point, however there was general agreement the explanation of the discrepancy between the centre of glaciation and the present north pole by purely geographical reasoning was welcomed as a relief from the difficult assumption of a shift of the poles

The difficulties of detail are threefold In the first place Penck and Brückner s simple scheme of four major glaciations cannot be applied directly to countries outside the Alps In the British Isles for example the succession was much more complicated than that suggested in Dr Simpson's scheme, and even the number of major glaciations has not yet been determined The second difficulty concerns the place in the scheme of the archæological stages Some competent authorities place the Acheulean not in the Riss Würm interglacial but in the Mindel-Riss, which according to the theory was cold and dry Even the climate in which Acheulean man lived has not been surely determined for the interglacial which contains Acheulean implements also includes a loess Allied to this is the difficulty that the Great Chalky Boulder Clay has features which show that the end of that particular glaciation was dry, though by Dr Simpson's scheme it leads up to a wet warm interglacial Finally, one of the fossils used most definitely as an index of a warm climate—*Corbicula fluminalis*—has recently been found associated with a marine cold fauna, and its climatic value is open to doubt Dr Simpson was not worried by these objections maintaining that if his theory is correct he had given geologists a useful means of aligning new discoveries, while existing discrepancies would gradually be cleared up

One interesting point brought out in the discussion was that no difficulty exists from the astronomical point of view in the sun being a variable star A range of 40 per cent means very little in terms of stellar magnitude, and is unimportant compared with some known variations

Obituary

PROF W H WELCH

THE death of Prof William Henry Welch of Baltimore on April 30 at the age of eighty four years removes from the scientific world a man who enjoyed an international reputation as a reformer of medical education sanitarian pathologist and bacteriologist

Shortly after obtaining his medical degree at Yale, Welch spent two years in Europe, where he studied normal histology pathology, physiological chemistry and practical medicine at Strasbourg, Leipzig Breslau and Vienna under the leading teachers of that day, visited various Paris hospitals and attended Lister s lectures at King s College Hospital London He was thus fully equipped with the latest and best medical teaching on his return to New York in the spring of 1878, where he was soon appointed lecturer on pathology at Bellevue Hospital Medical College

In 1884 Welch was made professor of pathology at Johns Hopkins University and pathologist to the Johns Hopkins Hospital Before entering on his new office, he made another journey to Europe, where he studied bacteriology and hygiene under von Pettenkofer, von Flügge and Koch On his return he played an important part in the development of the Johns Hopkins Hospital, and was largely responsible for the election of the other three original members of the staff, namely, Osler, the physician, Halsted, the surgeon, and Kelly, the gynæcologist, who figure with him in Sargent s well known picture From 1893 until 1898 he was dean of the Johns Hopkins Medical School, being succeeded by Osler In 1916 he was appointed the first director of the new School of Hygiene and Public Health at Baltimore and held this post until 1926, when he became professor of the history of medicine in the Johns Hopkins University

Welch's work may be summed up under the headings of sanitation, pathology, bacteriology and medical education As president of the Maryland State Board of Health—an office which he held for twenty four years—he played an important part in converting Baltimore, which had hitherto been a focus of typhoid fever, into a healthy city His advice on sanitary matters was often sought by presidents of the United States and other public authorities, and it was due to him that a Yellow Fever Commission was created, which led to the discovery of the rôle of the mosquito in the spread of the disease He was the author of numerous important articles on pathology, the best known being those on thrombosis and embolism, which were published in 1899 in Allbutt's "System of Medicine" In 1892 he described the *Staphylococcus epidermidis albus* and the *Bacillus aerogenes capsulatus*, the cause of gas gangrene, commonly known as the Welch bacillus.

As medical educationist, Welch is to be credited with having introduced modern methods into the medical schools of the United States and to have trained a large number of pupils, jocularly described as 'Welch rabbits', who afterwards attained a high distinction in the world of medical science

MR H. G. MILLER

AGRICULTURISTS all over Great Britain will hear with deep regret of the death of Henry G. Miller, son of Dr. G. W. Miller, of Dundee, and until lately manager of the experimental farms at Rothamsted and Woburn.

Miller was born in Dundee in 1903 and was in the first instance intended for an engineering career; he entered on the engineering course at the University of Glasgow for this purpose, but his desire had always been towards agriculture and he soon transferred to the agricultural side, and afterwards to the University of Edinburgh. At both places he achieved remarkable success. He was then appointed to an Empire Cotton Growing Corporation scholarship and proceeded to the University of Cambridge and afterwards to the Imperial College, Trinidad, where he studied tropical agriculture and especially cotton growing.

Finding that tropical conditions did not suit him, Miller returned to Great Britain and was appointed farm manager at Boghall, the experimental farm of the Edinburgh and East of Scotland Agricultural College. His work here attracted attention from discerning observers and when the farm managership of Rothamsted became vacant in 1927 he was appointed to it.

Two important tasks were entrusted to Miller at Rothamsted. One was to complete the programme of converting a wholly arable farm without animals into a mixed grass and arable farm carrying a considerable head of livestock. This was done with great energy and efficiency and with a minimum of disturbance of the experimental work. The other task was to deal with the cultivation problems associated with the new methods of field experimentation designed in the Statistical Department at Rothamsted for the purpose of giving an estimate of the error of the experiment, a quantity which agricultural experiments had usually ignored in the past. In collaboration with his colleagues at Rothamsted, methods were worked out which satisfied the requirements both of the cultivator and the statistician.

Miller's personal bent was towards experiments on sheep, and several of these were begun at Rothamsted and will be continued. Perhaps the most interesting was the selection of a number of four-teated ewes and rams from four teated mothers, on the basis of which a little flock is being built up to see whether this character is advantageous to a ewe suckling twins.

Miller's death is a great loss to agriculture as he was a man of undoubted promise. He combined to an exceptional degree the qualities of hard work, enthusiasm and genius for agriculture, and had he lived he would have been marked out for a brilliant career.

News and Views

Lieut.-Col. S. P. James, F.R.S.

THE Darling Medal and Prize was founded by the Health Section of the League of Nations in memory of that great malariologist, Dr. S. T. Darling, who met his death as the result of a motor accident in the Lebanon Mountains outside Beirut when carrying out malaria inspection work for the League. The choice of Lieut.-Col. S. P. James as the first recipient of this award is a most appropriate one, for malaria and the problems associated with it have occupied the foremost place in his mind since he first joined the Indian Medical Service in 1896. In India he carried out important pioneer work on the anopheles mosquitoes and their classification, and laid the foundations of the subsequent malaria work which has been accomplished in that country. He pursued other lines of research, and, independently of Low but a little later, was able to demonstrate that the embryos of *Filaria bancrofti* in their development in the mosquito pass ultimately into the proboscis of the insect, so that there is every probability that infection occurs when the mosquito feed. On his retirement from the Indian Medical Service in 1918, after war service in Mesopotamia, James joined the Local Government Board, now the Ministry of Health, as adviser in tropical diseases. There he was instrumental in organising and developing the malaria treatment of general paralysis in mental hospitals and asylums.

THE opportunity this gave of studying malaria under carefully controlled conditions was fully realised by Col. James, and, as a result, there was established at the Horton Mental Hospital the now well known laboratory, which has been the means of bringing to light a whole array of new and important facts regarding the biology of the various malarial parasites, including the comparatively new form *Plasmodium ovale*, the diseases they produce and the factors which govern the action of quinine, plasmoquin, atebrin and other drugs in their treatment and prevention. The results obtained at this laboratory, which has been visited by nearly all the best known malariologists and has been copied in other countries, have had a profound influence on malarial thought and action throughout the world. As a member of the Malaria Commission of the Health Section of the League of Nations, Col. James has taken an active part in its deliberations and recommendations and has visited most malarial countries, where his wide experience of the disease in all its aspects has enabled him to give valuable advice as to the methods which should be adopted to control this most widespread of all diseases. Col. James is still pursuing his investigations, and there is no doubt that he will continue to add to our knowledge of those minute parasites which are inoculated to man by mosquitoes, and attack the red blood corpuscles with such disastrous results. We wish him every success in his further endeavours.

U S National Academy of Sciences Awards

It is announced by Science Service that the Elliot Medal for 1931 has been awarded to the late Prof Davidson Black, of the U S National Academy of Sciences, for his researches on the skull of Peking man The medal and honorarium is awarded annually for work on zoology or palæontology The first award of the Charles Doolittle Walcott Medal and honorarium of 1,350 dollars of the Academy has been made to Dr David White, of the U S Geological Survey, in recognition of his work on the pre Cambrian algæ of the Grand Canyon of Arizona, which are among the very oldest of plant fossils Other awards just announced are Agassiz Medal, to Dr Bjorn Helland Hansen, of the Geophysical Institute, Bergen Norway, Public Welfare Medal, to Dr David Fairchild formerly of the U S Department of Agriculture and the Elliot Medal and honorarium of 200 dollars for 1930, to Dr G E Coghill Wistar Institute of Anatomy and Biology, Philadelphia

U S National Academy of Sciences

At the meeting of the National Academy of Sciences held in Washington on April 23–25, the following elections were made *Members* Prof V Bush, professor of electrical engineering and vice president of the Massachusetts Institute of Technology, Prof H S Gasser professor of physiology, Cornell University Medical College New York, Prof E N Harvey professor of physiology, Princeton University, Prof D R Hoagland professor of plant nutrition University of California, Prof E O Lawrence, professor of physics, University of California, Prof J F Norris, director of the research laboratory of organic chemistry Massachusetts Institute of Technology, Dr J H Northrop, biochemistry member of the Rockefeller Institute, Prof C Palache, professor of mineralogy, Harvard University, Dr T M Rivers pathology member of the Rockefeller Institute, Prof E Sapir, Sterling professor of anthropology and linguistics, Yale University, Dr E C Stakman plant pathologist U S Department of Agriculture, Prof H S Vandiver, associate professor of mathematics, University of Texas, Prof N Wiener, professor of mathematics, Massachusetts Institute of Technology, Prof S Wright, professor of zoology University of Chicago *Foreign associates* Prof V F K Bjerknes, professor of meteorology in the University of Oslo, Prof Robert Robinson, Waynflete professor of chemistry in the University of Oxford

Native Lands in Kenya

Any apprehension that the rights and sentiments of the Kenya natives in the matter of their lands are likely to be endangered by future government action, taken without full knowledge, should be allayed by the Report of the Kenya Land Commission which has now been issued with a White Paper stating the views of the Government (Cmd 4556, 11*s* and Cmd 4580, 2*d*) The appropriation of a part of the native reserve in the development of the Kakamega gold fields, notwithstanding arguments advanced in justification, aroused a feeling of uneasiness and a fear lest any policy of development, however short sighted, might in future be allowed to override obligations or measures framed to preserve the integrity and ultimate stability of native society The report of the Commission and the supporting body of evidence, which examine native claims relating to the land in detail, tribe by tribe, provide a permanent record defining the position in native land tenure, and at the same time by recommending that the Native Lands Board no longer exercise administrative functions but be devoted entirely to the office of protection—a recommendation accepted by the Government—ensures that, given a satisfactory constitution of the Board the interests of the native as determined in this combination of Domesday and Magna Charta, shall not go by default Further, the Board is given the power of veto over leases of land exceeding ten acres in extent The principle of leasing is to take the place of exclusion of land from the reserve and exchange, the land thereby remaining part of the reserve This, together with the requirement that native opinion shall be consulted is not only in harmony with the sentiment and practice of the natives but also avoids the more objectionable features which have hitherto appeared in land development

The Commission does not confine itself to present grievances and difficulties but has a clear view of the future development of the native Not only are 1,474 sq miles added to the native reserve in satisfaction of present claims but also a further area, totalling in all more than 2 000 sq miles, is to be set aside to meet present and future economic requirements In part of this additional area the system of tenure is to be more elastic than in the native reserve Tribal tenure will no longer be the only system, and the tendency of the native towards other forms of the economic unit will be recognised In other words, the native will be afforded an opportunity to habituate himself to a form of tenure more nearly in accord with the economy of European civilisation It is also suggested—though this recommendation will not be adopted until it has been considered by the local legislature—that certain reserve boundaries should be eliminated or modified to permit intertribal expansion and interpenetration The trend in these recommendations towards a modification of native culture is carried further in the stress laid on the necessity for a less wasteful use of the land and the references to proposals for restriction of the excessive number of cattle now carried As cattle form the currency and wealth of the native, should these proposals be given effect, he must needs accustom himself to some new form of wealth Up to the present, the increased resources which civilisation has brought to the native, in so far as they are not absorbed in the acquisition of an excessive number of cattle, would appear mainly to have been expended wastefully On the whole, it may be said that in its outlook on the future, the report, recognising that the native is entering upon a period of transition in which traditional culture must suffer modification, has suggested lines on which development will bring about the least dislocation and can most effectively be brought under an enlightened control

Petrol from Coal

THOSE who have maintained that the successful production of petrol from coal would prove of incalculable benefit to our long languishing coal industry will derive much satisfaction from a reply given in the House of Commons on May 17 Mr Mitcheson asked the Secretary for Mines if he could furnish an estimate of the increased consumption of coal in Great Britain which has resulted from the imposition of a duty on fuel oil The Secretary for Mines (Mr Ernest Brown), in reply, said Official information is not available But a short time ago I received a deputation from the Coal Utilisation Council and other bodies, which furnished detailed information, collected by various trade organisations This showed that, in terms of coal, there had been conversions from oil to coal and coal products, and business retained which it was stated would, but for the tax, have been lost to home produced fuels representing an annual rate of consumption of over 600 000 tons "

Sexual Selection in the Pheasant

THE Zoological Society of London has just received a noteworthy addition to its Gardens in a pair of Rheinhardt's Argus pheasants (*Rheinhardtius ocellata*) for this is one of the rarest of the pheasant tribe Those who are interested in problems of sexual selection will find these birds well worth thoughtful study, for they present a striking contrast with the commoner and better known Argus pheasant (*Argusianus*) This bird occupied a prominent place in Darwin's Descent of Man', on account of the enormous development of the secondary wing feathers, the like of which is seen in no other bird These feathers are also remarkable for their ornamentation, which consists of a series of ocelli which as Darwin pointed out, when they are displayed in the courtship attitude, look like a series of balls lying within a cup shaped socket, while the primaries are marked by a pattern of indescribable beauty The wings of Rheinhardt's pheasant lack any form of ornament, and in shape conform to the usual type of pheasant wing The tail feathers, however, are prodigiously long and marked by a pattern of considerable beauty This striking difference in the secondary sexual characters in these two birds is puzzling Nothing seems to be known of the nature of the display of *Rheinhardtius* in its amorous moods It is to be hoped, therefore, that the new arrivals will greatly enlighten us on this point The display of the wings in the Argus pheasant is unique, the two wings being widely spread so as to form an enormous circular fan completely concealing the rest of the body It affords an unanswerable argument to those who hold that birds in 'display' are not conscious of their finery

Mathematics and Cosmic Research

IN a lecture entitled World Gravitation by Kinematic Methods" given by Prof E A Milne before the London Mathematical Society on May 17, his hearers had the thrilling experience of seeing a possible model of the universe constructed before their eyes by a simple, but wholly brilliant application of apparently trivial mathematical methods Starting with Newtonian time, Prof Milne envisaged the behaviour of a set of particles of which the description given by an observer placed at any one of them would be the same as that given by an observer placed at any other The hypothesis leads to certain functional and differential equations from the solution of which Prof Milne deduced a statistical model of extreme elegance The astonishing result was obtained that in a given volume of the observer s space there are particles the velocity of which is arbitrarily near that of light On this, Prof Milne showed how a theory of cosmic rays and obscuring matter in interstellar space could be based The striking simplicity of the method and the far reaching character of its interpretations open up a new vista of possibilities for cosmic research

Demonstration of Television

ON May 15 a demonstration of the use of the cathode ray tube in television reception was given before the Electrical Association for Women at the showrooms of the Edison Swan Electric Co Ltd, London After a very clear and non technical exposition of the basic principles had been given, the B B C 30 line transmission was received The results obtained suggested that the cathode ray tube is capable of giving as good an image as the limitations of the transmission will permit There was very little flicker, owing to the large afterglow of the fluorescent material of the screen The latter was of the usual type giving a green image, the use of white fluorescent screens is not considered desirable at the low picture frequency at present in use, as the afterglow with these is much less The scanning is accomplished by means of two small oscillators giving voltages of saw tooth wave form and appropriate frequencies which are applied to the two pairs of deflecting plates, the incoming signals hold these oscillators in synchronism with the transmitter and also modulate the intensity of the electron beam Difficulty was experienced in keeping the picture steady during the demonstration, but this was attributable to the exceptionally bad local reception conditions It was stated that in normal circumstances the controls need not be touched during the whole transmission period of half an hour The advantages claimed for the cathode ray tube are that it is noiseless, that signals of good headphone strength only are required to operate it, and that by the alteration of a few minor circuit components it can be easily adapted to suit transmissions of different numbers of lines and picture ratios The last point is important in view of the uncertainty in the future development of television Suitable tubes can now be marketed at six guineas and this price could be substantially reduced if the demand became large enough As the auxiliary apparatus required is not excessive, and can be assembled from standard components, the system is quite practicable for domestic use

New Electric Lamps

IN a paper read to the Royal Society of Arts on March 7, Mr J W Ryde of the G E C Research Laboratories, Wembley, gave a full account of the working of the new electric discharge lamps The sodium discharge lamp is practically monochromatic and of a brilliant yellow colour Hence coloured objects illuminated by it all appear to be various shades of brown Its efficiency about 40 lumens per watt, although three times that of the ordinary filament lamp, is yet only about a tenth of the maximum possible yellow light that could be obtained for the same power It is well known that the efficiencies of all kinds of electric lamp vary with their life The problem of candle power maintenance is one that constantly engages the attention of every lamp manufacturer In spite of years of research the light output of incandescent filament lamps still drops by a certain amount after several hundred hours burning The candle power maintenance for the new lamps has now been raised to a reasonable figure, but it is recognised that considerable improvements are possible It is rapidly approaching that of the filament lamp At present there is no sign that the eminently simple and highly developed filament lamp will shortly be replaced by discharge lamps for purposes of indoor illumination, but it must be admitted that discharge lamps will play an ever increasing part in the future of electric lighting Already there are 65 street lighting installations for which these lamps have been adopted Street lighting is the one use of artificial lighting for which we have never produced enough light The use of the new lamps is an excellent opportunity of improving the lighting of our streets at little if any, increase in the cost

Importance of Deep Borehole Surveying

DESIGNERS of apparatus for surveying deep boreholes have in the past consistently underestimated difficult engineering problems necessarily attendant on such surveys On April 10, W E Bruges read a paper before the Institution of Petroleum Technologists in which he made some pertinent remarks on the usefulness of well surveys as an adjunct to drilling logs and geological data Geologists can utilise the results of accurate surveys for correcting underground contours, choosing such surface locations as will ensure economic spacing of wells in the oilsand below and making deductions as regards the formation as a whole from direction deviation and irregularities of the hole as portrayed by the survey Administration is facilitated by a knowledge of exact spacing of wells in an oilfield Decisions regarding drilling activities can be taken with confidence, and the risk of overcrowding, hence decreasing production, is minimised Recent experiments in Burma have shown that of available apparatus for this work, that designed and manufactured by Martienssen is the most satisfactory The instrument is fitted with a gyroscope for obtaining direction and two pendulums for inclination, results being recorded photographically It has the advantage that the gyroscope is unaffected by magnetic influences, while the pendulum method of obtaining inclinations allows a number of readings to be taken at one run Photographic recording of results means that the instruments below ground can be light, obviating necessity of following up gear, moreover, their relative places in the well can be photographed without disturbing position or setting

Automobiles Run by Charcoal Fuel

IN Italy, automobiles have recently been operated on a gas fuel made in transit from charcoal and steam It is recalled in a recent paragraph issued by Science Service, of Washington, D C, that similar experiments were made in France and other European countries several years ago The principle involved is the same as that used in the manufacture of some kinds of gas employed in operating stationary internal combustion engines A carbon containing material usually coal is heated, and then water in the form of steam is passed over it Carbon monoxide and hydrogen are formed in this process and both these gases burn with high heat output Mixtures of this sort are known as water gas or producer gas This gas can be used as fuel in internal combustion engines The drawback to using these gas engines in motor vehicles is the difficulty of carrying the fuel supply In permanent locations they can be used very effectively for power generation To a limited extent, vehicles that run on wood or charcoal and manufacture their own gaseous fuel as they go along are used commercially in France Science Service points out that this type of self propelled vehicle may become important in countries like France and Italy which have no petroleum supplies within their borders In the United States on the other hand, owing to the cheapness and availability of petroleum there would be no need for this kind of vehicle In those countries where imported oil supplies are likely to be interrupted in war time automobiles using charcoal fuel would have advantages.

Science and Industry in the U S S R

IN a recent publication entitled Organisation et Principes de L'Enseignement en U.R.S S" (Paris Hermann et Cie, 6 Rue de la Sorbonne) Prof Jean Trillat gives an interesting description of the relations between science and industry in Soviet Russia One of the most important transformations brought about by the Russian revolution has been the establishment of compulsory education, and this in turn has led to a considerable development of scientific studies Prof Trillat points out that in order to understand correctly the nature of educational and scientific progress in Russia, it is essential to remember that there such developments have been based on a materialistic philosophy The religious mysticism of pre War Russia has now been replaced by the mysticism of the machine The conception of science in Soviet Russia is that of an auxiliary to socialism Education figures as a definite part of the Five Years Plan, and the Educational Plan comprises a general scheme of public education, the preparation of technicians and scientific workers from among the working classes, together with a general scheme of scientific research and the establishment of numerous scientific institutes The author describes a number of these institutes which he visited including the physico technical Kombinat at Leningrad with its subsidiary institutes of physical chemistry and electro physics In addition, it has an experimental workshop of a unique character which manufactures scientific instruments for the Kombinat ' and other institutes Employing about 300 workers it is a half industrial and half scientific organisation Soviet industry has thus behind it very extensive means for scientific research, and the various problems, classified according to interest or urgency are investigated by the specialised chemical physical or electrical institutes

Chemical Researches in Czechoslovakia

EVER since the middle of last century, much chemical research work has been carried out at Prague Some of the investigations, notably Prof B Brauner's work on atomic weights and on the rare earth elements, attracted wide attention but much valuable if less spectacular, work was overlooked Few Czech men of science published in English journals, the majority of their researches appeared in the little read Czech publications To direct more attention to their achievements, Czechoslovak chemists founded in 1928 under the joint editorship of Profs Votoček and Heyrovsky the *Collection of Czechoslovak Chemical Communications*, in which the contributions were written in French or English Among the more interesting contributions that have appeared recently in this journal mention may be made of the discovery by Prof Křepelka and Dr Novotny that mercurous halides show marked triboluminescence the actual intensity depending on the conditions of preparation Prof Šimek has also made some observations on the curious electrical behaviour of fused tellurium dioxide In organic chemistry, Drs Landa and Machaček have described a new solid hydrocarbon, $C_{10}H_{16}$, to which they assign the name adamantane A series of researches by Prof Votoček and his collaborators has cleared up a number of points in connexion with the lesser known sugars such as rhamnose, rhodeose and fucose Prof Heyrovský has also published a series of papers (referred to in NATURE of March 10, p 385) dealing with his polarographic studies with the dropping mercury cathode

The Indian Chemical Society (1924–1932)

PROF B K SINGH's presidential address to the Indian Chemical Society (*Journal of the Indian Chemical Society*, vol 10, No 1, p 1, 1933) deals with "Optics in the Service of Chemistry ', and includes a review of recent work on optical rotatory power and rotatory dispersion, to which he has himself contributed He also records in a tabular form the growth of the Indian Chemical Society, during the nine years of its existence During the first five years the growth was rapid, but the Society has held its own during the more difficult years from 1929 until 1932 It now includes 360 fellows and 100 subscribers, and is publishing approximately 100 papers in each year, of which 750 pages are printed free of cost by the University of Calcutta Under these favourable conditions an income of about 10 000 Rs has usually provided a credit balance, and a reserve fund of 21 000 Rs has been built up in addition to a donation of 10,000 Rs from Sir P C Rây which is earmarked for the provision of a headquarters for the Society

Schlieren, Striæ or Streaks?

IN the January issue of the *Journal of Scientific Instruments* Mr T Smith, of the National Physical Laboratory, raises the question whether it is fair to Foucault to continue to describe the method he introduced for observing small optical differences of path by the name schlieren used for the method by Töpler in his paper of 1866 on the motion of singing flames Messrs Taylor and Waldram, who had used the term schlieren in their paper in the December issue of the *Journal*, point out that Töpler in giving the method that name made no claim to its invention but only to an extension of the use of it to general scientific investigations Would striæ or streaks be adequate equivalents of, and suitable alternatives for, *schlieren* ?

Uniformity in Bibliographical Particulars

REFERRING to recent correspondence on this subject (NATURE, 133, 380 March 10, 495, March 31, 1934), Mr A Windelbandt, bibliographer in the library of the Institute of Plant Industry, Leningrad, writes pointing out the practical value of accurately given bibliographical citations in articles and books Mr Windelbandt states that footnotes and other references are often given in such a way as to make it impossible to recognise the publication While the name of the author is quoted, the title of the article is often omitted and sometimes it is difficult to identify the journal owing to the manner in which the name is abbreviated The absence of the year and volume in the case of articles, and the place of publication and name of publisher in the case of books also renders it difficult for the reader to find the publication Lack of pagination, too, may lead to a lengthy search, if a volume has no special index.

Institute of Physics

THE annual general meeting of the Institute of Physics was held at the Royal Institution on May 15 After election of the officers and completion of the panel of the Board, it was announced that the following would take office on October 1 next: *President*, Sir Henry Lyons, *Vice President*, Prof W L Bragg, *Honorary Treasurer*, Major C E S

Phillips, *Honorary Secretary*, Prof J A Crowther, *New Members of the Board*, Dr Allan Ferguson and Mr R S Whipple In pursuance of one of the main objects of the Institute, namely, to urge the importance of Physics in Industry", the Board has decided to arrange a two day conference in the spring of 1935 on the applications of X ray structural analysis to various industries The main function of the conference will be to bring to the notice of industrialists what physics and physicists can do to help industry rather than the discussion of technical matters among experts The conference will be held in Manchester in conjunction with the local section of the Institute, and it is proposed to arrange an exhibition and visits in connexion with the meetings Full details will be announced in due course

Ancient Chinese Books on Materia Medica

In the year A D 659, an illustrated volume of materia medica was published in China It seems to have served until about 1061 when an extensive revision took place Prof Manzo Nakao has studied the history of this great compilation (Notes on Shao hsing Hsiao ting Ching shih Chêng lei Pei chi Pên tsao (The Ancient Chinese Materia Medica Revised in the Sung Dynasty Shao hsing period 1131 1162)" *J Shanghai Sci Inst* (3) 1, 1 9 May 1933) Much of the subject matter of the paper is of interest only to the Chinese historian but some of the descriptions show that the work was very thorough, and covered at least 22 volumes There were apparently several distinct revisions The medicines can all be recognised, and the historical investigation was stimulated by the possibility of reviving some of the ancient remedies under modern conditions

"World List of Scientific Periodicals"

The second edition of the "World List of Scientific Periodicals will be published in one volume by the Oxford University Press on June 30, at the price of £3 3*s*, but subscribers in advance will receive it at £2 2*s* Such subscribers resident in Great Britain or Europe must post their cheques before June 30, or if outside Great Britain or Europe before July 30 The new edition will contain titles and holdings of periodicals current right up to the end of 1933 The number of libraries the holdings of which are listed has been increased by 39, the number being 189 as against 150 Approximately 10,000 new titles have been added, the total number of entries amounting to 36,380 Each entry contains the title and place of publication of the periodical, the abbreviation, and the symbols for the libraries in which it is to be found and the dates of their holdings Further information can be obtained from the Secretary, "World List of Scientific Periodicals', c/o The Zoological Society of London, Regent s Park, London, N W 8

Announcements

The annual visitation of the National Physical Laboratory, Teddington, will be held on Tuesday, June 26, at 3-6 p m

The annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 2 The new 36 in reflecting telescope will be opened by the First Lord of the Admiralty at 3 p m, and the Observatory will be open for inspection by invited guests at 3 30 p m

Prof Louis Martin has been elected director of the Pasteur Institute of Paris in succession to the late Dr Roux, with whom he had been closely associated

Prof J Barcroft will deliver the Stephen Paget Memorial Lecture at the annual general meeting of the Research Defence Society at the London School of Tropical Medicine and Hygiene, Keppel Street W C 1, on June 5 at 3 p m The subject of Prof Barcroft's lecture will be ' Experiments on Man '

The attention of chemists is directed by the Union Internationale de Chimie to the services rendered by the International Bureau of Physico Chemical Symbols in placing at their disposal pure organic compounds the constants of which have been determined with great accuracy The specimens supplied by the Bureau are guaranteed as possessing the constants of the values given in the published proceedings of the Bureau (*J Chim Phys*, vols 23, 25 27, 29 and 31) They can be obtained at cost price from the Secretary of the Bureau, Prof J Timmermans, University Brussels from whom further information can be obtained

The McGraw Hill Publishing Co, Ltd, has issued its catalogue for 1934, containing a classified list of its books on agriculture zoology and botany The catalogue can be obtained post free from Aldwych House, London, W C 2

Applications are invited for the following appointments, on or before the dates mentioned —An assistant in the Inquiry Bureau of the Building Research Station, Garston—The Secretary, Department of Scientific and Industrial Research 16, Old Queen Street, Westminster, S W 1 (May 30) A professor of botany at the University of St Andrews —The Registrar (May 31) An assistant keeper of Oriental printed books and MSS in the India Office Library—The Establishment Officer India Office, Whitehall, S W 1 (June 1) A lecturer (woman) in mathematics (biology or botany subsidiary), at the Darlington Training College—The Principal (June 4) A lecturer in physics and elementary science at the City of Leeds Training College—The Director of Education, Education Department, Calverley Street, Leeds (June 5) A curator of the Museum and Art Gallery at Barking—The Town Clerk, Town Hall, Barking (June 7) An assistant agricultural organiser to the Northamptonshire County Council—The Secretary for Education, County Education Offices, Northampton (June 9) A professor of electrical technology at the Indian Institute of Science, Bangalore, India—The Director (Aug 1) A University professor of mining at Imperial College of Science and Technology—The Academic Registrar, University of London, S W 7 (Jan 14, 1935)

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Radio Exploration of the Ionosphere

(*a*) *Measurement of the earth's magnetic field in the ionosphere*

The discovery[1] of magneto-ionic doubling of wireless echoes returned from the ionosphere and its explanation[2] in terms of the theory of double refraction have provided us with a method of estimating the intensity of the earth's magnetic field at the level from which the waves are reflected. The way in which the earth's magnetic field is related to the observational data was indicated by Appleton and Builder, who showed that under conditions of quasi-longitudinal propagation relative to the direction of the magnetic field, we have

$$H = \frac{2\pi m}{e}(f_e - f_o) \qquad (1)$$

where H is the total magnetic intensity, f_e and f_o are respectively the critical penetration frequencies of the extra-ordinary and ordinary waves for any particular region, and e and m are the charge and mass of an electron. For conditions of quasi-transverse propagation, on the other hand, the corresponding formula is

$$H = \frac{2\pi m}{e}\left(\frac{f_e^2 - f_o^2}{f_e}\right) \qquad (2)$$

It was further shown by Appleton and Builder that their experimental results, obtained under conditions of quasi-transverse propagation, agreed approximately with (2) when the value of the earth's magnetic field at the ground was used for H, so that their observations could be interpreted as indicating either the approximately quantitative correctness of the magneto-ionic theory or that the magnetic field in the ionosphere does not differ very markedly from its value at ground level.

If we assume the quantitative correctness of the magneto-ionic interpretation of the results, it is obvious from equations (1) and (2) that we have here a method of measuring the magnetic field in the ionosphere. During the past year, I have therefore made as careful measurements as possible of the value of H for the upper ionised region during nocturnal conditions when critical frequency measurements are most reliable, my object being to look for small variations of H such as might be caused by the upper atmospheric currents envisaged in present-day theories of terrestrial magnetism[3].

The detailed examination of these results is still in progress, but one result of interest has emerged from the first series of two hundred measurements. The average value of H calculated from (2) is found to be 0.42 gauss. Now the value of the earth's total magnetic field at the surface of the earth in south-east England is 0.467 gauss, so that the radio observations suggest that the average magnetic field in the ionosphere is about 10 per cent less than its value at the ground.

Now, according to Schmidt, the earth's magnetic field intensity above the surface may be expressed, as a first approximation, by $H_0\,(1 - 3h/R)$ where H_0 is the ground value, h the elevation and R the earth's radius. The values of the magnetic field at 200 and 300 km. above the earth's surface in south-east England should therefore be 0.42 and 0.40 gauss respectively. It will be seen that the value obtained by the radio methods is of about this order of magnitude.

(*b*) *A new method of ionospheric investigation*

One of the fundamental quantities measured in the study of the ionosphere is the group time for a signal to travel to the stratum of reflection and back to the ground. To measure such a group time, we must impress some kind of mark on the signal in order to recognise it on its return. Now the essential characteristics of an electric wave are frequency and amplitude, and the two basic methods of group time measurement are thus those involving frequency modulation and amplitude modulation. It must not be assumed, however, that in their simple forms they always represent the most convenient ways of marking a signal for group time measurements, and I have recently found that there are sometimes advantages in combining the methods so as to produce a frequency change on a pulse emitter. It will readily be seen that in doing this we extend the frequency range examined in the experiment and obtain, in effect, information comparable with that which we should get with an extremely brief pulse. This means that we can investigate the structure of echoes which are normally unresolved.

As an example of the use of this combination method, as I propose to call it, let us consider the case of an unresolved magneto-ionic doublet. If the mean frequency of the emitter is varied continuously through a sufficiently large range, we get interference effects in the echo itself, so that any component amplitude varies through a series of maxima and minima. If in this case, a linearly polarised receiver aerial is used, we have

$$c\,\frac{\Delta n}{\Delta f} = P'_o - P'_e \qquad (3)$$

where P'_o and P'_e are the equivalent paths of the ordinary and extraordinary waves, Δn the number of interference fringes produced by a change of frequency Δf and c is the velocity of light.

When apparatus is available for providing automatic maintenance of sender and receiver tuning during the frequency change, such as that first described by Gilliland, the usefulness of the combination method may be strikingly demonstrated. For example, in a test carried out at Slough at 1530 on March 8, 1934, using an apparatus of similar principle designed by Mr. L. H. Bainbridge Bell, an alteration of mean frequency of from 4.0 to 4.2 mc./s. produced five interference fringes in a first order F region reflection. This corresponds to an equivalent path difference for the two magneto-ionic components of 7.5 km., or to a difference in equivalent height of 3.75 km. It is obvious that differences in equivalent height of 1 km. or less can be detected in this way.

The work described above was carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

E. V. APPLETON

Halley Stewart Laboratory,
King's College, London.
May 14.

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[1] Appleton and Builder, *Proc. Phys. Soc.*, 44, 76; January 1932.

[2] Appleton and Builder, *Proc. Phys. Soc.*, 45, 208; March 1933.

[3] Cf. McNish, *Terr. Mag. and Atmos. Elect.*, 39, 5; March 1934.

Atomic Disintegration by 'Non-Capture'

It has been assumed[1] that the nucleus of an atom may be disintegrated by either (1) a process in which the projectile (A), which is another nucleus, is captured, or (2) one in which it is not captured

$$(1)\quad A + B \rightarrow (AB) \rightarrow C + D$$
$$(2)\quad B \rightarrow C + D$$

These are illustrated in Figs 1 and 2

While the evidence for the occurrence of disintegration by capture is so good as to be undisputed, that for non capture is less convincing

Probably the best evidence for disintegration by non capture is that given by photographs of tracks of the disintegration particles C and D, where the projectile A is a neutron and B is a nitrogen nucleus Thus Feather, in a discussion of his excellent work with neutrons, says of these about thirty resulted in disintegration, more than half of the latter without capture of the neutron"[2]

In this laboratory about a hundred disintegrations of nitrogen nuclei by neutrons were photographed[3], and of these, 26 were of such high quality as to give good measurements For 17 of these it was found that the straight line (a) for A passes directly through the source These may be assumed to represent *disintegrations by capture*

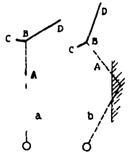

FIG 1 Capture

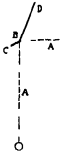

FIG 2 Non-capture

The remaining nine might be considered as possible cases of non capture However, in one of these the tracks C and D were turned in such a way as to prove that the neutron could not have come in a straight line from the source, that is, it was a scattered neutron

The values for the velocity of the incident neutron, assuming non capture, were calculated from the best five photographs both by our equations involving rest masses (3) or including the complete relativity relations (4) as given below

$$V_A = \frac{M^2 + 2m_A\,(E_C + E_D + E_m)}{2m_A\,M\cos\alpha} \qquad (3)$$

or

$$V_A = \frac{M}{2m_A\cos\alpha} + \frac{(E_C + E_D + E_m)}{M\cos\alpha}, \qquad (3)$$

where V_A and m_A are speed and mass of projectile, M is magnitude of resultant momentum of B and C, E_C and E_D are their kinetic energies, E_m is energy corresponding to increase of mass in the reaction, or $E_m = c^2\Delta m$, α is angle between V_A and direction of $\bar{M}$

It is assumed that a γ ray is not emitted However, an approximate solution may be obtained if the term $E\gamma$ is added to the quantity between the parentheses, since the momentum of the γ ray is, in general, negligible

The relativity equation, similar in form to (1), may be written

$$V_A = \frac{c\,(w^2 - K^2) + 2k_A cK}{2k_A w\cos\alpha} \qquad (4)$$

in which $k_A - k_A' \equiv K$ and $\frac{k_A\bar{V}_A}{c} - \frac{k_A'\bar{V}_A'}{c} \equiv w$

and c is the velocity of light

It was found (a) that the velocities thus calculated were *very much higher than those of any known neutron* However, if (b) it is assumed that the disintegrations correspond to Fig 1b, that is, the neutron is first scattered and then gives a disintegration by capture, the neutron velocities for the nine disintegrations are not only of the right order of magnitude but also the distribution curve which plots number of events against velocity of the neutron, is *the same as that obtained for the disintegrations* caused by neutrons directly from the source

Thus the evidence seems to indicate that these disintegrations also occurred with capture of the neutron It seems reasonable to conclude that there is at present no evidence which proves that any nucleus has been disintegrated by a non capture collision Obviously this does not prove the non occurrence of disintegrations of this type

We wish to thank Prof A C Lunn for his co operation

WILLIAM D HARKINS
DAVID M GANS

University of Chicago,
Chicago, Ill
March 23

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[1] Chadwick and Gamow NATURE, 126 54 July 12 1930 Chadwick Constable and Pollard, *Proc Roy Soc* A 130 463 1930 Feather *Proc Roy Soc*, A 136 709 1932

[2] loc cit p 720

[3] Harkins Gans and Newson *Phys Rev* 44 529 1933

X-Ray Photographs of Crystalline Pepsin

FOUR weeks ago, Dr G Millikan brought us some crystals of pepsin prepared by Dr Philpot in the laboratory of Prof The Svedberg, Uppsala They are in the form of perfect hexagonal bipyramids up to 2 mm in length, of axial ratio $c/a = 2\ 3 \pm 0\ 1$ When examined in their mother liquor, they appear *moderately birefringent and positively uniaxial*, showing a good interference figure On exposure to air, however, the birefringence rapidly diminishes X ray photographs taken of the crystals in the usual way showed nothing but a vague blackening This indicates complete alteration of the crystal and explains why previous workers have obtained negative results with proteins, so far as crystalline pattern is concerned[1] W T Astbury has, however, shown that the altered pepsin is a protein of the chain type like myosin or keratin giving an amorphous or fibre pattern

It was clearly necessary to avoid alteration of the crystals, and this was effected by drawing them with their mother liquor and without exposure to air into thin capillary tubes of Lindemann glass The first photograph taken in this way showed that we were dealing with an unaltered crystal From oscillation photographs with copper $K\alpha$ radiation, the dimensions of the unit cell were found to be $a = 67$ A, $c = 154$ A, correct to about 5 per cent This is a minimum value as the spots on the c row lines are too close for accurate measurement and the *c* axial length is derived from the axial ratio The dimensions of the cell may still be multiples of this Using the density measured on fresh material[2] as 1 32 (our measurements gave 1 28), the cell molecular weight is 478,000, which is twelve times 40,000, almost exactly Svedberg's value arrived at by sedimentation in the ultracentrifuge This agreement may however be quite fortuitous as we have found that the crystals contain about 50 per cent of water removable at room temperature But this would still lead to a large molecular weight, with possibly fewer molecules in the unit cell

Not only do these measurements confirm such large molecular weights but they also give considerable information as to the nature of the protein molecules and will certainly give much more when the analysis is pushed further From the intensity of the spots near the centre, we can infer that the protein molecules are relatively dense globular bodies, perhaps joined together by valency bridges but in any event separated by relatively large spaces which contain water From the intensity of the more distant spots, it can be inferred that the arrangement of atoms inside the protein molecule is also of a perfectly definite kind although without the periodicities characterising the fibrous proteins The observations are compatible with oblate spheroidal molecules of diameters about 25 A and 35 A arranged in hexagonal nets which are related to each other by a hexagonal screw axis With this model we may imagine degeneration to take place by the linking up of amino acid residues in such molecules to form chains as in the ring chain polymerisation of polyoxy methylenes Peptide chains in the ordinary sense may exist only in the more highly condensed or fibrous proteins, while the molecules of the primary soluble proteins may have their constituent parts grouped more symmetrically around a prosthetic nucleus

At this stage, such ideas are merely speculative but now that a crystalline protein has been made to give X ray photographs, it is clear that we have the means of checking them and, by examining the structure of all crystalline proteins, arriving at far more detailed conclusions about protein structure than previous physical or chemical methods have been able to give

J D BERNAL
D CROWFOOT

Department of Mineralogy and Petrology,
Cambridge
May 17

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[1] G L Clark and K E Korrigan (*Phys Rev* (ii) 40 639 1932) describe long spacings found from crystalline insulin but no details have been published

[2] J H Northrop *J Gen Physiol* 13, 739 1930.

IT is now some time since we first took X ray powder photographs of crystalline pepsin kindly sent by Prof J H Northrop, but no really satisfactory interpretation of these photographs presented itself because they show features which we have learnt recently to associate with the fibrous proteins[1] even single crystals so far as we could judge with the minute crystals available, appeared to give results similar to those produced by many crystals in random orientation The two chief rings have spacings of about 11 5 A and 4 6 A at ordinary humidity, corresponding to the 'side chain spacing' and the 'backbone spacing', respectively, of an extended polypeptide[1].

It was difficult, of course, to reconcile such findings with external morphology and the Law of Rational Indices, but the photographs of Bernal and Miss Crowfoot, taken before the degeneration which we now see the crystals must have undergone on drying, clear up this long standing problem at once Furthermore, their photographs tend to confirm the suggestion[2] that the numbers 2, 3, 4, and 6 occurring in Svedberg s multiple particle weights are fundamentally of *crystallographic* significance, even though their conclusions to date appear to be against the chain mechanism proposed for the building up of the various crystallographic groups[2]

We are left now with the paradox that the pepsin molecule is both globular[3] and also a real or potential, polypeptide chain system, and the immediate question is whether the chains are formed by metamorphosis and linking up of the globular molecules, or whether the initial unit is the chain itself which is afterwards folded in some neat manner which is merely an elaboration of the intra molecular folding that has been observed in the keratin transformation[1] What is either an exceedingly valuable clue or else only a fantastic coincidence is found in the fibre photograph of feather keratin[4] a study of which will be published shortly , for if, as Bernal thinks, the pepsin molecules are piled, perhaps in a screw along the hexad axis, their length in this direction is 140/6, that is, about 23½ A , which is almost exactly the strongest period along the fibre axis of feather keratin, a period which is again repeated probably six (or a multiple of six) times before the fundamental period is completed ! The innermost equatorial spot of the feather photograph also corresponds to a side spacing of about 33 A (though this is probably not the maximum side spacing) which again is in simple relation to the side dimensions of the pepsin unit cell As just said, these resemblances may be only accidental, but we cannot afford to overlook anything in such a difficult field and it is not impossible that we have here an indication of how very long *but periodic*, polypeptide chains can arise by the degeneration and linking up of originally globular molecules

W T ASTBURY
R LOMAX

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[1] W T Astbury *Trans Faraday Soc* 29 193 1933 W T Astbury and A Street, *Phil Trans Roy Soc* A 230 75 , 1931 W T Astbury and H J Woods NATURE, 126, 913, Dec 13 1930 *Phil Trans Roy Soc* , A 232 333 1933 W T Astbury and W R Atkin NATURE 132 348 Sept 2 1933

[2] W T Astbury and H J Woods NATURE 127 663 May 2 1931

[3] J St L Philpot and Inga Britta Eriksson Quensel NATURE 132 932 Dec 16 1933

[4] W T Astbury and T C Marwick NATURE 130 309 Aug 27 1932

Transitions to Optical Levels in the Argon *L* X-Ray Absorption Spectrum

THE so called fine structure of X ray absorption edges is caused by the possibility of transition of an inner electron to *different* upper levels, these levels being more or less discrete for the lowest energies and approximately continuous for the higher ones In the ordinary X ray region, the fine structure observed with crystalline absorbers usually extends over more than 100 v from the main edge It was pointed out by Kronig[1] that in this case the discrete character of the upper states 'may be considered as due to the wave character of the motion of a 'free' electron in the *periodic field* of the lattice This conception has been successfully applied to many cases[1]

In some cases, however, it seems more natural to visualise the upper states in a slightly different way, namely, as optical orbits' of the *single* atoms[3] This would seem to apply in the first place to monatomic gases like argon, and perhaps also more or less to some cases of fine structure observed at small distances (<20 v) from the main edge in solids and molecular gases

A narrow fine structure of the argon (18) *K* edge found by Coster and van der Tuuk[4] was explained by the authors in this way They remarked that in this case the upper levels in question should lie very close to the optical levels of potassium (19), as the absence of the inner electron will make itself felt in the outer regions of the atom in much the same way as an increase of the nuclear charge by one unit Owing, however, to the small energy resolution in the ordinary X ray region, the authors were not able to establish the predicted correspondence conclusively, though they showed it to be a probable explanation for the experimental results

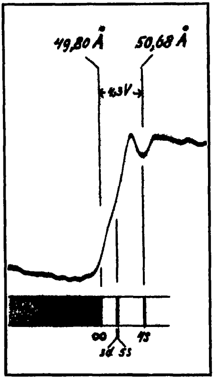

FIG 1 Comparison of the argon $L_{II\,III}$ absorption spectrum (upper curve) with the optical spectrum of potassium (lower figure) on the same energy scale

Now recently I have photographed the absorption spectra of some gases and vapours in the ultra soft X ray region by the plane grating method, giving a resolution of about 0 5 v The vacuum spectrograph[5] was filled with the gas at a pressure of 0 5 mm mercury or less, the X ray tube being closed against the spectrograph by a thin film of cellulose nitrate

In Fig 1 the photometric record of one of my plates for argon (18) is reproduced together with the energy spectrum of potassium (19) on the same scale It will be seen that the correspondence between the two figures to be expected on the above considerations seems to exist, provided the *p* levels of potassium be omitted These are not indicated in the figure, but as they would lie between successive *s* levels, their presence would make the correspondence less satisfactory Now this omission of the *p* levels is just what is to be expected *if the ordinary selection rules apply* to this case, as the inner electron removed is itself a *p* electron and so should pass over to *s* and *d* levels only. Of course the multiplicity is higher in our case than with the spectra of the alkalis, but we may neglect the spin altogether[6] and consider the argon atom approximately as a certain central field of force in which the absorbing electron in question jumps from one 'orbit' to another

From Fig 1 and other analogous curves, the number of absorption electrons per atom' or strength of the virtual oscillator corresponding to the transition $2p \rightarrow 4s$ may be estimated at about 0 005, which seems a reasonable value from a theoretical point of view[6] Regarding the experimental width of this absorption line, it may be remarked that it is not due to insufficient spectroscopic resolution, but represents a real phenomenon inherent to X ray absorption and emission lines and connected with the existence of the Auger effect, etc

Analogous fine structures are present in other cases[5] The full report is to appear in *Physica*

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March 22

[1] R de L Kronig *Z Phys* 70 317 1931 J D Hanawalt *J Franklin Inst* 214, 569, 1932

[2] D Coster and J Veldkamp *Z Phys* 74, 191 1932

[3] W Kossel *Verh d D phys Ges*, 18, 339 1916

[4] D Coster and J H van der Tuuk NATURE 117 586 April 24 1926

[5] *Z Phys*, 81 507 1933 and 84 65 1933

[6] *Z Phys* 77 478 1932

Isotope Effect in the Band Spectrum of Aluminium Hydride

IN a previous letter[1], we published some preliminary results from an investigation on the band spectra of AlH and AlD As a remarkable result, we stated that the ratio of the reduced masses of both molecules, $\rho^2 = \frac{\mu_{AlH}}{\mu_{AlD}}$, has a mean value 0 51897, deviating considerably from the value $\rho^2 = 0\ 51848$ to be expected when applying the known atomic weight figures to the general expression of the reduced mass of diatomic molecules $\mu = \frac{Mm}{M + m}$, M and m representing the atomic weights of aluminium and the respective hydrogen isotopes

Considering possible causes for this discrepancy, we now find it most probable that it arises from an uncritical application of the expression for μ In the case of a metal hydride, where the centre of gravity is situated close to the heavy metal nucleus, a small correction in the effective moment of inertia I arises from the contribution of the electronic system To a high degree of exactness the moment of inertia can be written as follows

$$I = \mu r^2 + \iota_e,$$

where μ refers to the reduced mass of the molecule, deduced as before, and ι_e represents the moment of inertia of the electronic system in the metal atom Assuming that the electronic system partakes fully in the rotation and vibration of the molecule, that is, suppose there is no lag of the inner shells in aluminium, a rough estimation of this correction on the basis of classical theory with electronic orbits leads to $\rho^2 = 0 5190$, in good agreement with the spectroscopic value A more refined calculation of the electronic effect, using methods given by Thomas[2] and Hartree[3], leads to $\rho^2 = 0 51892$ As a matter of fact, this value is in surprising agreement with our latest value, $\rho^2 = 0 51889$, obtained from recalculation of the spectrum, based on improved measurements

W HOLST
E HULTHÉN

Laboratory of Physics,
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April 23

[1] NATURE 133 496 March 31 1934
[2] *Proc Camb Phil Soc* 23 542 1927
[3] *ibid* 24 89 1928

Enzyme Catalysis of the Ionisation of Hydrogen

THE well known analogy between the colloidal metallic catalysts and certain enzymes early suggested to us the inclusion of the latter in our survey of catalysts for the ionisation of hydrogen[1], and the work of Stephenson and Stickland on hydrogenase[2] indicated the most promising material for investigation Work has now been in progress for some time on several strains of *Bact Coli* and on *Bact Acidi Lactici*, and we wish to make a preliminary report of our results—the more so as the announcement of a forthcoming paper by Hughes, Yudkin Kemp and Rideal includes a brief reference to work which may be following parallel lines

We have found that these bacteria are able, like platinum black, to catalyse the reaction

$$HD + H_2O \rightarrow H_2 + HDO,$$

and in the case of *B Acidi Lactici* we have measured the first order velocity constant ($K = \frac{1}{t} \ln \frac{C_0}{C}$) at 37° for a known number of organisms

Number of Organisms		Partial Pressure of Hydrogen	Initial Atomic per cent Diplogen	K in min $^{-1}$
Total 5×10^{11}	Living $2 2 \times 10$	360 mm	1 06	0 0065

The 'total' number of organisms was estimated by comparison with standard (killed) suspensions, the number living by dilution and agar plate count The bacteria, which in each case were washed three times in 0 85 per cent saline (with centrifuging) and finally aerated before use, were presumably in the 'resting' state (so far as the living are concerned) Partially 'heavy' hydrogen and the (de aerated) saline suspension of the bacteria were the only materials present in the (sealed) reaction vessel, which was vigorously shaken

B CAVANAGH
J HORIUTI
M POLANYI

University,
Manchester
May 17

[1] NATURE, 132, 819, Nov 25 1933 *et alia*.
[2] *Biochem. J*, 25, 204, *et alia*

Breathing Movements of Whales

WHALES, when breathing, usually keep on the move, the purpose of this letter is to explain why All aquatic air breathing creatures have to contend with the risk of water entering their lungs Although the blow holes of whales are valvular and situated on the highest part of the head, these animals, usually, can only breathe with safety when their blow holes are at some height above the surface of the sea

Owing to their shape, whales usually can only bring their blow holes into a favourable position for breathing by coming up to the surface obliquely at some speed and as they only get time to take a single breath, they have to repeat the performance again and again The following extract from a paper by Racovitza[1] shows that this, in fact, is their usual behaviour

The whale, having returned to the surface, after a long immersion, emits a prolonged expiration, makes a short inspiration, dives a little, re appears to breathe, dives again, and then many times in succession, then it makes a long inspiration and plunges into the depths for a considerable time" Again, he says, 'the number of these intermediate immersions before sounding varies according to the species In general, whale bone whales execute but a few, the toothed whales very many In all cetaceans, however, they are characterised by the following (2) the interval between the re appearances is very short, (3) the animal dives only to a slight depth, (5) the whale, during the time it is under water, progresses quite rapidly, usually in a straight line"

The effort that whales require to make on these occasions seems to depend on the roughness of the sea, and the height of the animal's crown, on which the blow holes are situated, above the water The Greenland whale, or Bow head, is well off in this respect, owing to its high crown It is able to lie motionless with its blow holes a foot or two above the surface

Exceptionally, whales sometimes breathe while lying motionless at the surface This generally occurs where the sea is very smooth and applies more particularly to the Greenland whale and narwhal—whales that habitually frequent the ice

The Greenland whale frequently breathes while motionless or nearly so Indeed, in narrow situations it is difficult to see how it can do otherwise. Scoresby[2] says, 'Several (Greenland) whales being astir and the weather fine, we sent all our boats in pursuit These whales were rather numerous, four or five being sometimes seen at a time The usual stay of a whale at the surface for breathing is about two minutes, seldom much longer, but it was a remarkable circumstance in the conduct of these whales, that they remained regularly from five to fifteen minutes at a time, and some, nearly half an hour before descending out of sight During this long interval they were generally quite motionless."

Greenland whales, when there is no ice, probably behave in the usual way This in fact seems to be the case Sutherland[3], referring to Davis Strait and the 'fall' of the year when there is no ice, says, Whales are very numerous and, at the same time, they are so wild that it is almost impossible to approach them"

Narwhals are sometimes seen breathing while motionless, particularly in very fine weather and in narrow situations These animals are provided with a subcutaneous chamber connected with their single blow hole which may help to prevent water reaching their lungs Scoresby[4] says, "When respiring at the surface, they [narwhals] frequently lie motionless for several minutes with their backs and heads just appearing above the surface" Where there is no ice they probably behave in the usual way

Blue whales are occasionally seen amongst the ice, they seem to avoid narrow situations and, when breathing, are usually on the move Scoresby says It [the Blue whale] seldom lies quietly on the surface of the water but usually has a velocity of from four to five miles an hour"

In the Greenland Sea, outside the ice I have only seen Bottlenose whales breathing while motionless This occurred alongside and in lee of the ship where the sea was very smooth The weather was fine at the time They formed an interesting sight, and their breathing made a peculiar noise

R W GRAY

Exmouth
Feb 26

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[1] The Spouting and Movements of Whales Annual Report of Smithsonian Institution 1903
[2] Journal of a Voyage, p 287
[3] Voyage of the *Lady Franklin* and *Sophia* 2 324 1850–51
[4] Arctic Regions 1 494

Active and Inactive Forms of the Hormone Promoting Comb Growth

FUNK[1] has shown that the hormone promoting comb growth can only be extracted from the urine of men in the presence of large quantities of acid (see also Kabak[2]) By means of acid extraction I demonstrated the presence of about 40 capon units per litre in hundreds of batches of normal urine but I could not detect even 20 units per litre by injecting the fresh concentrated urine itself

I concluded that the hormone must be present in the urine in an inactive form, and therefore tried to isolate it in this state This has been accomplished by extracting fresh urine of men at its original *p*H (5 3) by means of butanol When testing this extract (after having taken it up in oil) the reaction of the capons was negative to doses which would have corresponded to 15 and 12 units per litre respectively From this it was supposed that the butanol extract contained the inactive form of the hormone for which I was seeking 240 c c of this extract, corresponding to 15 litres of urine, were boiled for 8 hours after the addition of 29 gm of trichloracetic acid The butanol was then washed with 10 per cent caustic soda and with distilled water, after which it was transferred into oily solution and tested in capons The product gave positive reactions in quantities equivalent to 27 and 40 capon units per litre

It is thus evident that the hormone promoting comb growth is present in the urine of men in an inactive form, in which it can be extracted by means of butanol The inactive form can be turned into the active one by boiling the extract with trichloracetic acid

A A ADLER

Organon Laboratories,
Oss, Holland
April 23

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[1] Funk C, B Harrow and A Lejwa *Proc Soc Exper Biol Med*, 26, 569 1929
[2] Kabak J M *Endokrinol* 9 84 250 1931

A Provitamin A other than Carotene?

A TURBOT concentrate estimated by spectrographic and colorimetric tests to contain 60 per cent vitamin A (the vitamin A of Carr and Jewell[1] taken to be 100 per cent) was irradiated in spectroscopic alcohol in the complete absence of air with light of wave length 300–390 mμ Solutions containing 0 0011 per cent vitamin A were found to be only slightly affected by exposures up to three hours' duration whilst solutions containing 0 00011 per cent were remarkably sensitive Solutions of this latter concentration were irradiated in lots of 60 ml for different periods and kept stirred during irradiation by a magnetic stirrer After irradiation of one lot it was evaporated *in vacuo* at 50° and brought to such a concentration as was equivalent spectroscopically at 328 mμ to a solution containing 0 0011 per cent vitamin A Its absorption curve in the ultra violet and its blue value were then determined

Irradiation up to three minutes caused a decrease in *E* and blue units, so that the concentrate which had a percentage vitamin A of 60, now shows a percentage of 30 Further irradiation caused a progressive increase in the spectroscopic and blue values, reaching a maximum after twenty one minutes irradiation when for the concentrate, a percentage vitamin A of 140 was given by the spectroscopic value, 130 by the blue value Further irradiation caused rapid destruction of the vitamin

The non irradiated concentrate in the blue value test showed a band at 565 mμ, after three minutes' irradiation the band had changed to 575 mμ, after twenty one minutes, 575 mμ Thus the chromogen responsible for the 565 mμ band is the precursor of the 575 mμ chromogen, which is either a purer vitamin A than that of Carr and Jewell or a sterol with very much higher spectroscopic and colorimetric values

A report of these experiments has been sent to the *Biochemical Journal*

EUGENE BOYLE

Killean,
Cloughogue,
Newry
April 23

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[1] NATURE 131 92 Jan 21 1933

China and the Maya Calendars

WITH reference to the note on the above subject in NATURE of January 13, p 68, the resemblances in the calendar systems seem to be exaggerated by Dr Kiang The Chinese day count follows the numbers 10 and 12 (L C M = 60) The Maya follows the numbers 13, 20 and 365 for the calendar round' of 52 vague years and the further factors 18 and 20 for the long count Apart from the mere principle of a continuous day-count with more than one concurrent numerator, the agreement is slight

A more striking 'coincidence' is the use of the 5 epagomenal days and the taboo during them, which agrees with Egyptian practice and so lends support to Prof Elliot Smith's diffusion theory

HERBERT CHATLEY.

Whangpoo Conservancy Board,
Shanghai
March 7

Research Items

Prehistoric Lincolnshire The first section of a survey of present knowledge of the prehistoric archæology of Lincolnshire by Mr C W Phillips is published in the *Archæological Journal*, 90 The county falls into well defined geographical divisions, of which the most important are the marked oolite ridge called Lincoln Edge and the Wolds There are two areas of low country, one, to south and east on the shores of the Wash, continuing round both sides of the Wolds and the other, the Isle of Axholme, on the west side of the outfall of the Trent into the Humber Although the geology of the lower grounds is not very conducive to prehistoric occupation, one of the surprises of the county archæology is the relatively considerable occupation of low lying lands at several periods There is little evidence of occupation of the county area in lower and upper palæolithic times In the microlithic period two areas of exposure of sand show evidence of occupation Risby Warren being regarded as the type site of Great Britain for this period In the neolithic period the discovery of nine, or possibly ten, long barrows on the Wolds has been one of the recent archæological surprises The builders were Windmill Hill folk Other neolithic objects except finds in the neighbourhood of Grantham and at Risby Warren belong to the Wolds The distribution of Early Bronze Age objects is such as might be expected when intruders from the North Sea were making their way into the county by the Humber and the Wash The distribution of beakers and daggers is entirely riverine, and there is evidence of only one landing on the coast The destruction of round barrows owing to agriculture has been great The majority stand on high ground away from the settlements In the Middle and Late Bronze Ages the distribution of the population did not differ materially from that of the early period of metal, being confined mainly to the valleys In the middle period the whole of Lincoln Edge from one end of the county to the other was occupied A novel feature was the beginning of the concentration around Brigg where a great dugout boat was found in 1886 Among gold objects found in the county two are important a gold armlet, now lost, and a torc with Y shaped section from the Isle of Axholme

Pre-Conquest Mexico In the fifth issue of *Ibero Americana*, the publication of the University of California Press which is devoted to the study of material relating to the geography or ethnology of Central America in early Spanish records, Dr Carl Sauer has reconstructed, so far as is possible, the distribution of aboriginal tribes and languages in north western Mexico, thus supplementing, and in some instances revising, the linguistic researches of Swanton, Thomas and Orozco y Berra The observations used are drawn from records dated between 1531, when Nuño de Guzman first entered the country, and 1768, when the Jesuits were expelled and the mission system began to come to an end It is not possible to confine the study of pre conquest conditions within narrower chronological limits, owing to the fact that while in the north Spanish influence was not felt until the end of the seventeenth century, in the south catastrophe overtook the native peoples at once Indians from central Mexico settled the country, in part as a replacement of the native on the land, in part as a baboo class intervening between the Spaniards and the indigenous population Wars, in which they suffered from the attacks of both sides, and the exploitation of the mines, were alike disastrous to the sedentary Indians, while in Sinaloa and Nayarit aboriginal conditions are impossible to recover owing to the establishment of *encomiendas* (villages granted as private possessions to individuals) in the sixteenth century, the grantees making good any deficiency in the labour supply by the importation of labour from outside, in some instances negro labour which rapidly brought into existence a mulatto population It would appear that the Aztec migration myth which asserts a wide spread distribution of Aztec people and culture, rests on the fact that Aztec speech was introduced as a matter of convenience into non Aztec areas by colonial settlers The Aztec place names quoted in evidence are in reality translations of indigenous names

Characteristics of Tumour Cells Prof Warren H Lewis summarises in Some Characteristics of Tumour Cells (News Bulletin, Carnegie Institution Washington) the principal differences between normal and tumour cells In the body, malignant cells show uncontrolled disorderly growth lack of useful function, rapid cell death, transplantability from animal to animal, injurious effect on normal tissues and acid metabolism The differences seen *in vitro* are more granular cytoplasm more refractive fat globules, smaller mitochondria, and no increase in neutral red granules The nuclear membrane is thicker, nucleolar material increased and the nucleus itself appears to be more granular The cells migrate more readily, and their shapes and general character in colonies help to differentiate them from one another and from the normal cells

Life-Cycle of a Human Echinostome Marcos A. Tubangui and Antonio M Pasco (*Philippine J Sci* , 51, 1933) have elucidated the life history of *Echinostoma* (*Euparyphium*) *ilocanum* a small human intestinal trematode discovered by Garrison (1908) in Manila The life cycle conforms to that usual for echinostomes Two molluscan intermediate hosts are involved , in the first, a small fresh water planorbid, are found the miracidium sporocyst redia and daughter redia stages, and from the last named the cercariæ escape and encyst in any of the common fresh water snails which form the second intermediate host The adult flukes were obtained by feeding encysted cercariæ from these snails to rats, a cat and two monkeys and it is concluded that human infestations are brought about by consumption of raw or insufficiently cooked snails harbouring the encysted cercariæ The limited geographical distribution of the fluke is explained by the observation that the habit of using raw snails as food is found only in the north west provinces of Luzon, that is, among the Ilocanos, The various stages are described and figured

Histology of Eye Mutants in *Gammarus* A series of colour mutations' in the eyes of the Amphipod *Gammarus chevreuxi* are well known to be inherited as Mendelian differences Wolsky and Huxley (*Proc*

Roy Soc , B, 114 364) have made a study of the histology and development of the eye in the various mutant types in comparison with the normal Eye colour mutants, such as red and no white, differ from normals only in pigmentation, while such eye structure mutants as albino and colourless show a structure which is markedly abnormal, the animals being blind The genes for the latter class of mutants might be likened to timed bombs which completely derange the development of the eye and adjacent structures The rate of development of the optic tract is slowed down and inhibited, especially in its distal portion, the retinular cells are deficient in number they fail to arrange themselves in groups of five and soon degenerate, while the interstitial cells show signs of hypertrophy The crystalline forming cells fail to form normal cones In explaining these results the following principles are utilised (1) alteration in the rate of a differentiation process, leading to inhibition , (2) an intensity gradient in the amount of inhibition , (3) development proceeding centrifugally in the optic tract , (4) struggle between parts leading to failure of the retinular cells and multiplication of the interstitial cells , (5) effect of the nervous system In the albino mutant, both the black melanin and red lipochrome pigments are absent because the retinulæ in which these pigments normally appear are suppressed

Chromosome Structure in *Allium* A detailed investigation of chromosome structure in *Allium*, by Prof T K Koshy (*J Roy Micro Soc* , 53, No 4), introduces several new conceptions The work of several other investigators is confirmed in showing that the chromosome is a double structure throughout the mitotic cycle Koshy goes further and shows that the chromomeric appearance frequently found in chromosomes is due to the close intertwining of two spiral chromonemata He also finds that the spiral of the chromonema is reversed at the point of the spindle fibre attachment constriction This is the point where the daughter chromosomes begin to separate in metaphase But before this has happened, each daughter chromosome has undergone a split into two chromonemata This is not a straight longitudinal split, but a spiral line of cleavage At about the time this spiral cleavage appears, the two daughter chromosomes in which it occurs unwind from each other just before the anaphase This unwinding proceeds from both ends towards the constriction where the reversal of the spiral takes place, this null point being regarded as a fulcrum The anaphase and telophase chromosomes thus contain two spiral chromonemata *owing to the spiral split in prometaphase* In late telophase the two threads are found to approximate very closely due to the elongation of the chromosomes, and their duality is thus obscured, but it reappears in the following prophase These observations have significant bearings on various current views in cytology and genetics They uphold the chromonema as against the chromomeric theory, and strongly support the generally accepted view that the anaphase and telophase chromosomes are double

New Gentians Capt F Kingdon Ward writes on "Some New and Rare Gentians" in the *Gardeners' Chronicle* of April 21 The wet zone to the south of the Great Wall of China provides a suitable habitat for *Gentiana stylophora*, *G gilvostriata*, *G setulifolia* and others, whilst the dry regions to the north of the Great Wall have other species There is a further subdivision of the dry parts into forest and grassland, each with its own gentian flora, though some species are very widely distributed The notes also include descriptions of several gentians introduced by Capt Kingdon Ward from Tibet last year *G Waltonii*, *G Georgii*, *G trichotoma*, *G filistyla*, *G Wardii*, *G sino ornata* and *G detonsa* are described, in addition to the three mentioned above The Lhagu gentian, a mat forming species, was found among the grassy slopes of the snow range at 14,000 ft , and promises to be a delightful plant if it can be introduced to cultivation

Geography of Earthquakes In a long article in *Matériaux pour l Etude des Calamités* (No 30–31, 1933) entitled Die Anthropogeographische Bedeutung der Erdbeben", Dr W Severit gives a useful summary of the geographical distribution of earthquakes in recent times with special reference to the more destructive ones A map shows the number of shocks during the last century This part of the memoir is followed by a discussion of the effects on soil, drainage, climate, human distribution and the works of man Finally, there is a study of the measures of prediction, security and relief The whole is well documented, and may usefully serve as an introduction to the subject

Wind Structure As a result of the special inquiry into wind structure that was carried out at Cardington a few years ago, by the Airship Services Division of the Meteorological Office, Mr C S Durst formed a novel theory of wind structure that explains many features shown on continuous records of the speed and direction of the wind such as those obtainable with the aid of the Dines' pressure tube anemometer In addition to the rapid and irregular fluctuations of speed and direction that are regarded as the result of irregular eddies with axes inclined in all directions, caused apparently by the striking of air against obstacles, Durst found large excursions of the speed and direction pens, generally lasting 1–30 minutes and showing as a rule a rapid initial increase of speed followed by a gradual decrease accompanied by increasing small disturbances of the frictional type just described There was abundant evidence that the initial squall corresponded with the arrival of faster moving air from a higher level, and that the whole phenomenon up to the beginning of another sudden increase of speed was associated with a local convectional circulation which he termed a 'cell', this circulation being superimposed on the general drift of the wind Mr Durst has recently discussed the anemograms from a number of places with anemometers having widely different exposures from this point of view (*Quart J Roy Met Soc* , Oct 1933) It is found that over the sea the frictional eddies are better developed in air of equatorial origin than in polar air, doubtless because the increase of wind with height is greater in the equatorial air, but that, given sufficient vertical stability in equatorial air over the sea, smooth flowing air can persist with higher speeds there than over agricultural land

Acuity of Vision Kruysuyk and Zwikker (*Physica*, 1, 4, Feb 1934) have published an account of experiments in which the acuity of vision was tested at different intensities of illumination, using as a criterion the recognition of small solid objects These were placed in effect at variable distances from the observer The acuity of vision was tested for several observers in white and in monochromatic sodium light The curves connecting intensity of light with acuity of vision slope upwards, following roughly a ½ power law, and show in general a bending over (saturation effect) at high light intensities, but this effect is much more marked for some of the test objects than for others For the lower intensities of illumination, the acuity at given intensity is much better for sodium light than for white light, but they tend toward the same saturation value The acuity is considerably greater and the effort of discrimination is less for two-eyed than for one eyed seeing

Valve Amplification at Radio-Frequencies A paper published by Mr F M Colebrook in the *Journal of the Institution of Electrical Engineers* of February 1934 discusses the relative merits of screen grid valves and three-electrode valves for amplification at frequencies of the order of a million cycles per second Voltage amplification by means of tuned circuits and screen grid valves is limited by conditions of stability and by the curvature of the amplification characteristic In the reception of broadcasting in particular, this curvature of the characteristic may lead to a reduction in apparent selectivity due to cross modulation, and an increase in background noise This effect is illustrated in the paper by typical measured amplification characteristics An analysis of a triode amplifying stage shows the possibility of securing inherently stable tuned circuit amplification by using a buffer valve stage to minimise the effects of the input impedance of the amplifying valve A measurement of such a stage at a frequency of a million cycles per second gave results in agreement with theory and showed that an output of about 100 volts could be obtained without appreciable curvature of the amplification characteristic Thus, although the three electrode amplifying circuit may not be preferable to the screen grid stage in all cases, it should facilitate reception at large power output with a minimum of audio frequency amplification With this object in view, special emphasis is laid in the paper on the desirability of making a simple modification to the design of the standard receiving triode in order to reduce the capacitance between the grid and anode.

Emission of Electrons in Chemical Reaction Denisoff and O W Richardson have published (*Proc Roy Soc*, A, March) a further instalment of the work on the emission of electrons when gases at low pressure react with sodium potassium alloy A refined re investigation of the reaction with phosgene has been made in order to determine the energy spectrum of the emitted electrons with considerable accuracy The paper summarises the general conclusions reached by these and by the former experiments—it is found that the energy distribution is not Maxwellian, as was formerly suspected, but that the distribution curve rises to a maximum at a certain energy and falls nearly to zero at a certain maximum energy, E_m Beyond this there is a very small tail, like that observed for the photoelectric effect For the chlorine compounds studied, $E_m + D$ is a constant where D is the dissociation energy of the compound The authors account for the distribution by supposing that the reaction between the metal atom and a chlorine atom to form a polar bond may be effected by a three body collision in which a metallic conduction electron carries off the surplus energy of the reaction The maximum energy E_m is thus the chemical reaction energy diminished by the work function of the metal This result appears to agree with experiment

Hydrazoic Acid Most of the reactions of hydrazoic acid, HN_3, support the conclusion that it is an ammono nitric acid

$$HONO_2 + 2NH_3 = H-N=N\equiv N + 3H_2O$$

(Franklin, *J Amer Chem Soc* March 1934) The potassium salt can be obtained by the reaction

$$KONO_2 + 3KNH_2 = KN=N\equiv N + 3KOH + NH_3$$

The action of the acid on metals is in many ways analogous to that of nitric (aquonitric) acid the evolution of hydrogen reported by previous experimenters does not occur with zinc, iron, manganese, nickel and copper, the products being the metallic azides, nitrogen (previously mistaken for hydrogen), and ammonia with small amounts of hydrazine, with magnesium (which also gives hydrogen with very dilute nitric acid), some hydrogen is also evolved A mechanism of reduction of the hydrazoic acid is suggested Hydrazoic acid does not dissolve gold, it will do so (as well as platinum) if mixed with hydrochloric acid, and the aqua regia" heated with the metal The mixture of acids also slowly evolves chlorine on boiling Ferrous azide is converted into ferric azide when heated with excess of hydrazoic acid, hydrogen sulphide is nitridised' (rather than oxidised') to sulphur, and sulphur to sulphuric acid by hydrazoic acid, and a stannous salt can be converted into a stannic salt by a fusion reaction with sodium azide Several organic reactions are also in agreement with this structure It may be mentioned that there is physical and physico chemical evidence besides the chemical evidence given in Franklin's paper, that hydrazoic acid and its salts have not the ring structure often given but a linear structure $H-N=N\equiv N$ or more strictly, $H-N=N\overset{\rightarrow}{-}N$, as proposed originally by Thiele

Stellar Photometry in the Infra-Red A new type of photoelectric photometer employing a cæsium oxide cell, has been described by J S Hall (*Astrophys J*, 79, 145) It is only possible to use this type of cell for stellar photometry if it is cooled to about −40° C by means of solid carbon dioxide, in order to reduce the dark current', or current which flows when no light strikes the cathode The colour curve of such a cell shows great sensitivity in the infra red, and intensity measurements may be made at well separated effective wave lengths A detailed description of the apparatus is given, as used in conjunction with the Loomis cœlostat telescope of the Yale Observatory The Pleiades were used for calibration purposes, and colour observations made on 347 stars and on the variable star ζ Geminorum The phases in the light curve of this variable as observed in the infra red are later than those observed in the visual, corresponding to the previously noticed phase difference between observations in the visual and the blue regions An interesting suggestion is made as to the possibility of finding the absolute magnitudes of giant stars of later spectral types from accurately measured colour excesses, observed in this manner in the infra red

Dipole Moments and their Interpretation

FEW branches of physical chemistry can show a more rapid development than the study of dipole moments. The theoretical work of Debye goes back to a discussion of the Mosotti-Clausius equation in 1912, but the experimental work really begins with Zahn's measurements on gases in 1924 and the work of Smyth, Williams and others on solutions a few years later. To-day, values of the dipole moment have been determined for more than a thousand substances, and measurements of dielectric properties are applied to such varied topics as the determination of valency angles, the size of colloid molecules, and the order of the boiling points of isomeric substances. It is not surprising therefore that the discussion on 'The Determination and Interpretation of Dipole Moments' held by the Faraday Society at Oxford on April 12–14 attracted a large number of British and foreign workers in this field. The outstanding figure was, of course, that of Debye; those who attended the meeting will long remember his shrewd comments on every paper, his genial smile and his cigar which served so aptly as a model of a dipole.

It is only possible to mention a few of the many papers which were read. The first group was concerned with the determination of electric moments of molecules. It seems to be generally agreed that atomic polarisations are small and are rarely greater than 5 c.c. Anomalous dipole moments can now no longer be ascribed to large values of P_A. On the other hand, the work of Horst Muller, Jenkins and others shows clearly that the magnitude of the dipole moment deduced from measurements in solution is influenced by the dielectric constant of the solvent. A number of formulæ connecting measured polarisation and dielectric constant were discussed, but much more work on vapours as well as on solutions is needed before the solvent effect can be accurately determined.

Debye's opening paper contained an account of novel work by Martin on dielectric losses in dilute solutions of a polar substance in a non-polar solvent. Following Malsch, the thermal expansion of the solution was used as a delicate method of measuring the heat developed by absorption of electrical energy. Non-polar substances gave negligible heating but polar substances showed a marked effect. Thus with 0·1 molecular solutions of orthodichlorobenzene ($\mu = 2·25$D*) and paradichlorobenzene ($\mu = 0$), the relative heating effects were in the ratio 310 : 1. Theory indicates that the effect should be proportional to the square of the dipole moment μ, and from the measured energy absorption the relaxation time of the polar molecule can be computed. In accordance with elementary theory, this is found to be of the order of 10^{-11} seconds for solutions in solvents of low viscosity, such as benzene. The elementary theory assumes spherical molecules and Stokes's law, and the experimental data diverge considerably from the predicted results. It seems probable that further investigations along these lines may give information about the shapes of molecules.

Determinations of relaxation time from measurements of anomalous dispersion at high radio frequencies were discussed in the papers contributed by Williams and by Girard. The latter finds anomalies in the shape of the dispersion curve for glycerol which he ascribes to the presence of two species of molecules, namely, normal and associated molecules. Girard also notes some curious empirical relations between the dielectric properties of hydroxyl compounds. Thus for the normal aliphatic alcohols from propyl alcohol upwards, the product of the molecular weight and the dielectric constant at 20° C. is nearly constant.

Another group of papers was concerned with the problem of free rotation. There is, of course, a mass of chemical evidence in favour of free rotation about a single bond. More accurately, it should be said that if isomerides exist which differ in structure merely by the relative angular orientation of groups about a single bond, then these isomerides are so readily interconvertible that they cannot be isolated. Dipole moments give a good deal more information about such rotations. Thus the existence of a dipole moment for hydroquinone dimethyl ether is explained by the rotation of the $-$OMe groups about the C$-$O bond. Williams and others have discussed molecules of the type of ethylene dichloride and distinguished three extreme cases: (*a*) the repulsions between the chlorine atoms fixes them in the *trans* position giving $\mu = 0$, (*b*) the chlorine atoms are fixed in the *cis* position and $\mu = 3·6$D, (*c*) the CH_2Cl groups rotate freely about the C$-$C axis with all orientations equally probable and $\mu = 2·5$D. Zahn has measured the dipole moment of ethylene dichloride in the vapour state and finds that it varies with temperature from 1·12D at 32° C. to 1·54D at 281° C. This is interpreted as indicating that the *trans* position is the most stable, and that increasing *thermal vibrations give oscillations from this position*. The problem is, however, one which deals with phenomena on the atomic scale and can only be solved satisfactorily by the methods of wave mechanics. An illuminating discussion of the restriction of free rotation in molecules of the type XCH_2CH_2X was given by Lennard-Jones. From suitable molecular models a wave equation was set up and an equation obtained which accounts quantitatively for the change of dipole moment with temperature.

Another interesting quantum discussion of a similar problem was given by Penney and Sutherland on the structure of hydrogen peroxide and hydrazine. These molecules give unexpectedly large dipole moments, which have been ascribed to free *rotation. An examination of the problem by quantum* mechanical methods shows that the main forces determining the structure of the molecule are not the electrostatic repulsion between the terminal hydrogen atoms but the interaction between the electron clouds associated with the oxygen atoms in HOOH and the nitrogen atoms in H_2NNH_2. The most stable configuration for hydrogen peroxide is a skew one in which the planes through the O$-$O axis and the H atoms are nearly at right angles. In other words, the most stable position is about halfway between the *cis* and *trans* positions. A similar structure is found for hydrazine; for both substances the observed dipole moments are in fair agreement with the values calculated for the skew configuration.

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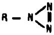
* D is the Debye unit, 10^{-18} E.S.U. C.G.S.

A group of papers was devoted to the discussion of resonance phenomena Here one is concerned primarily with the rapid oscillation of electrons between different positions in the molecule, and not with the movements of nuclei as in the free rotation problem The problem of the structure of the organic azides was discussed by Sidgwick The azido ion has undoubtedly the linear structure N=N=N, for the covalent organic azides three structures are possible as shown below Parachor and volatility favour I, whilst chemical reactions, electron diffraction, and recent crystal structure measurements reported by Bernal indicate a linear structure, II or III The dipole moments of a number of azides give for the moment of the Ph–N_3 group about 1 5D This is scarcely larger than the moment of the Ph N group, so that the links in the N_3 group contribute very little to the moment II and III should give large contributions in the senses indicated by the arrows below the formulæ, so the dipole moments seem to favour structure I This is, however quite incompatible with the electron diffraction and crystal measurements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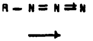
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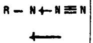
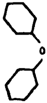

III

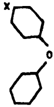
The low moment cannot be reconciled with a linear arrangement of the nitrogen atoms by postulating tautomerism in the chemical sense of the word between forms II and III If the time of interchange between the two forms is less than the relaxation time (c 10^{-11} sec), then each form would orient under the influence of the applied field and the observed moment would be large although the two forms have moments of opposite sign Quantum mechanical resonance between the two forms with an interchange time of the order of 10^{-15} sec would account for the observed moment For this to occur it is necessary for the two forms to have equal or nearly energies Sidgwick has computed the heats of formation of the N_3 group making certain plausible assumptions with the following results

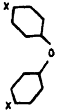
I, 170 k cal II, 191 k cal III, 180 k cal

The observed value calculated from the heats of combustion of organic azides is 211 k cal This seems to exclude I and is compatible with resonance between II and III, since resonance increases the stability of the molecule and would increase the heat of formation

The vector addition of dipole moments and the calculation of valency angles were considered in another group of papers The chief difficulty met with in this field is the uncertain magnitude of the interaction between two dipoles in a molecule or between a dipole and the polarisable part of the same molecule Hampson described a method of eliminating such errors considering the moments of a series of compounds, for example







where X is a group of known moment From the three measured moments it is possible to fix upper and lower limits for the valency angle and to estimate the magnitude of the perturbing induced dipole along the X O axis For the oxygen valency angle consistent values of about 130° were found, the induced dipole was small when X was Cl but when X was NO_2 amounted to half a Debye unit

Finally mention must be made of the remarkable results found by Hassel for certain cyclohexane derivatives 1 4 dichloro, dibromo and di iodo cyclohexane were found to have zero moment in solution in benzene This result is not easily reconciled with the usual view that cyclohexane derivatives consist of a tautomeric mixture of two strainless forms with a non planar configuration

S S

University Statistics of Great Britain

UNIVERSITY statistics of Great Britain for the year 1932–33, recently issued by the University Grants Committee*, show that the attendance of students has been well maintained and university finances have a healthy appearance It would seem that the measures taken to temper the effect on universities in Great Britain of the inclement economic weather prevailing in the past few years have achieved their object The enrolment of full time students has been gradually rising since 1924–25 and showed last year a further increase of 1 255—1,267 more men and 12 fewer women Of the aggregate total of 50,155, five per cent were engaged in research and other advanced work, seventy seven per cent were reading for a first degree and eighteen per cent for a diploma Part time students numbered 13,960, of whom rather more than half were not pursuing regular courses leading to a degree or diploma

A regional distribution of the full time students gives to London, 24 per cent, Oxford and Cambridge, 21 per cent, provincial universities of the Midlands and northern England, 21½ per cent, Reading, Southampton, Exeter and Bristol, 5 per cent; Wales 6½ per cent, and Scotland, 22 per cent

Students from abroad, that is, from homes outside the British Isles, numbered 5,870—about one tenth of the total number—considerably more than half of them being from countries within the British Empire these show, however, a tendency to decrease in proportion to those from foreign countries The following table gives particulars in respect of universities where such visitors from abroad were most numerous, showing (1) full time students from places outside the British Isles but within the Empire, (2) those from foreign countries, and (3) the percentage of (1) plus (2) to the total number of students

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* University Grants Committee Returns from Universities and University Colleges in receipt of Treasury Grant Academic Year 1932–33 Pp 26 (London H M Stationery Office 1934) 1s 3d net

	Students from abroad		(Per cent)
	(1)	(2)	(3)
London	1 191	674	16
Sch of Economics	141	234	39
Imperial College	163	50	20
University Coll	221	118	17
Guy's Hospital	99	18	14
St Bart s Hospl	78	34	15
Oxford	290	234	11
Cambridge	346	192	9
Birmingham	28	85	11
Edinburgh	329	176	14
St Andrews	14	87	11

In view of current controversies and world wide perplexity in regard to economic doctrine, it is noteworthy that the London School of Economics draws so many students from abroad

Analysis according to subjects of study reveals a substantial increase of 807 (eight per cent) in the number of medical students and a falling off of five per cent under agriculture

University finances, which are to a large extent dominated by State aid—parliamentary and local authorities' grants together amounting to 44½ per cent of the aggregate of university incomes—have called for close and unremitting attention on the part of university administrative authorities since the national financial crisis of 1931 Evidence of the effectiveness of their control is to be found in the fact that there were only four institutions the accounts of which showed deficits on the year and in only one was the deficit of any substantial amount The aggregate amount of debt on capital account at the close of the year was about one million pounds, or one sixth of the aggregate annual income

Expenditure on libraries is dissected in a special table which shows that of the total, £210,756, sixteen per cent was on account of purchase of periodicals, the increasing number and cost of which was already three years ago, when they were responsible for little more than ten per cent of library expenditure a source of embarrassment

Four London institutions now make their first appearance in the returns the Courtauld Institute of Art first opened in October, 1932, the Institute of Education (formerly the London Day Training College) transferred from the control of the London County Council to that of the University of London in September, 1932, the Institute of Historical Research statistics of which were previously not differentiated in the returns from those of the University of London as a whole, and the School of Slavonic and East European Studies transferred from King s College to the University of London in August 1932

Quantitative Methods of Biological Assay

THERAPEUTIC substances which cannot yet be completely defined by their physical and chemical characteristics, can only be used with safety when their activity has been determined by tests on animals The accuracy of such tests has been greatly increased during the last decade especially since it was realised that large numbers of animals must be used in each assay so that the average response of a group of animals can be determined, allowance thus being made for the differences in response of the individual animals Such tests may be of two types either the response of each animal to the drug is accurately measured, for example, the effect of insulin upon the blood sugar of the rabbit, or observation is only made as to whether some specific effect is produced or not for example, the effect of insulin upon the mouse, when the end point is the occurrence, or not, of convulsions Gaddum has recently made an analysis of the latter type of test and his report should be of great value in the interpretation of the results of such experiments *

In tests of the all or none' or 'quantal' type it is now usual to inject several doses of the substance under test into a series of animals ten or twenty or more being used for each dose, and to plot the percentage number responding on each dose against the dose given The curve which is then drawn to pass approximately through the plotted points is *S* shaped, the shape and slope of the curve being characteristic for each combination of drug and test animal species It is often more convenient to plot the effect of the drug against the logarithm of the dose (to base 10) instead of against the dose itself, the characteristic curves are then easier to interpret The most satisfactory index of the slope of the curve, and so of the uniformity of the animals, is the standard deviation of the logarithms of the individual effective doses, which can be estimated with sufficient accuracy by taking from the curve the log dose corresponding to 84 per cent subtracting from it the log dose corresponding to 16 per cent and halving the result

Gaddum also recommends that instead of using the percentage of responses on each dose as a measure of the effect the normal equivalent deviation be plotted against the logarithm of the dose, since this function gives a more satisfactory measure of the effect than the percentage does It is equal to the deviation from the mean, and is obtained in practice from tables When the normal equivalent deviations are plotted against the logarithms of the doses the points so obtained lie approximately on straight lines, when the logarithms of the individual effective doses are normally distributed It is therefore usually sufficient to use only two doses and to take the line joining them as an indication of the relation between the logarithm of the dose and the effect This line is completely described by calculating the dose which produces the effect in half the animals and the standard deviation of the logarithms of the individual effective doses

The report is illustrated by a number of curves obtained by different observers in assays of different drugs or hormones such as ouabain neoarsphenamine, oestrin and pneumococcus antibody The control of variables which affect the homogeneity of the animals used, such as their genetic composition, weight, age, sex, diet and environmental temperature, is also discussed The mathematical argument involved in the use of these curves is described and, in greater detail the methods of carrying out a test, two examples being included

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* Reports on Biological Standards (3) Methods of Biological Assay depending on a Quantal Response By J H Gaddum. Medical Research Council, Special Report Series No 183 (H M Stationery Office London, 1933) 1s net

University and Educational Intelligence

CAMBRIDGE —It has been recommended that one University lectureship in forestry be transferred from the Faculty of Agriculture to the Department of Botany, and that the lectureship be called the University lectureship in forest botany

LONDON —The following appointments have recently been made · Capt G T R Hill to the Kennedy chair of engineering (University College), Dr L P Garrod to the University readership in bacteriology (St Bartholomew's Hospital Medical College), Dr G R Cameron to the University readership in morbid anatomy (University College Hospital Medical School), Mr. John D Cowley to the directorship of the University School of Librarianship at University College

The Dunn exhibitions in anatomy and physiology for 1934 have been awarded respectively to Mr Alfred Cohen (University College) and Mr A J Bernfeld (Middlesex Hospital Medical School)

WALES —University College, Cardiff, has received a further gift of £1,000 from the Rothschild residuary fund It has been decided to expend the greater part of the sum on library purposes

Sir Howell Williams, of Corris, Merioneth, has promised £10,000 for the new college building scheme of the University College at Aberystwyth This scheme is estimated to cost £500,000 Lady Gladstone of Hawarden has offered to endow two Rendel Memorial Scholarships as a memorial to the late Lord Rendel

The University College of North Wales at Bangor celebrates its jubilee this year

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HISTORY and geography teaching, considered in relation to the problems of 'moral disarmament', is dealt with in several papers published in the December issue of the League of Nations' *Educational Survey* There is, first, the full text of a lecture by M Maurette, assistant director of the International Labour Office, giving a vivid presentation of methods whereby history and geography teaching in primary and secondary schools may help their pupils to grow up "to realise the only hope for the salvation of man on earth and the law which must govern the inhabitants of a globe whose limits are shrinking daily and whose different parts are becoming increasingly members one of another" It is followed by two authoritative *communiqués* concluding an acrimonious debate provoked by an article which appeared in a previous issue of the *Survey* The position of the writer of the article, Mrs Corbett Ashby, as a delegate at the Disarmament Conference necessarily aggravated the seriousness of her accusations that "national and racial animosity are inculcated by teachers in obedience to false ideals of morality" A communication from Dr C W Kimmins includes a memorandum by Dr C B Firth on the general characteristics of the way in which children are now encouraged to learn history in English schools, and emphasises that for the last twenty years the kind of geography taught in the majority of schools in England has been equally unlike anything that Mrs Ashby described and rightly condemned.

Science News a Century Ago

"Great Points in Electricity"

In 1834 Faraday was approaching the end of the electro chemical researches which had occupied him for the previous two years His paper on the 'Electricity of the Voltaic Pile" was read before the Royal Society in June of that year, and a few days earlier, on May 29, he wrote in his Diary a short passage which gives an interesting indication of his ideas on electrolytic conduction at the time He hoped that electrolysis might afford a means of distinguishing between elementary and compound bodies

The passage, which is headed "Great Points in Electricity which require to be decided", shows that he had grown accustomed to using the new word ion' 'Is not the existence of compound *ions* assumed rather than proved? Has an acid or a base yet been determined to the electrodes except in a solution, and would they go in equivalent proportions in ordny salt? In fact is it not the simple bodies only which truly and freely traverse? This not yet definitely decided "

'If there are, still, may we not by Electrical relations of the simple *ions* distinguish between real elements and such as we may think to be such because we have not decomposed them? That is, will not electricity prove to be the test between bodies really simple and those which are compound? If so, probably our present elements are true and ultimate elements "

Death of Laumont

On June 1, 1834, the French mineralogist, François Pierre Nicholas Gillet de Laumont, died in Paris Born on May 28, 1747, he was educated at a military school and served in the army from 1772 until 1784 He was then appointed an inspector of mines and devoted his leisure to the study of mineralogy He wrote many papers for the *Annales des Mines* and assisted in organising the Paris School of Mines The mineral laumontite was named after him by Hauy

London and Birmingham Railway

On June 1, 1834, at Chalk Farm, the first sod was cut for the London and Birmingham Railway, the first main trunk line in Great Britain The royal assent to the bill for its construction had been obtained on May 6, 1833, after a Parliamentary struggle which had cost the promoters of the line £72,869 Robert Stephenson, then thirty years of age, had carried out the surveys for the line, and though there was much opposition, the directors on September 7, 1833, resolved "That Mr Robert Stephenson be appointed engineer in chief for the whole line at a salary of £1,500 per annum, and an addition of £200 per annum to cover all contingent expenses, subject to the rules and regulations for the engineers' department, as approved by the respective committees" Fixing his residence in St John's Wood, and with the Eyre Arms Hotel as his office, Stephenson reserved for his own personal supervision a length of about nine miles from Maiden Lane, Camden Town, and divided the remaining 103 miles into four districts, each under an assistant engineer The actual construction of the line was entrusted to about twenty contractors, but the completion of some of the most difficult portions had to be superintended by Stephenson *himself* The work of the greatest magnitude was the construction of the Kilsby Tunnel south of Rugby, a costly undertaking rendered necessary through the short sighted opposition of the inhabitants of Northampton to the proposal that the line should pass by way of that town

John Dalton

Dalton was elected a fellow of the Royal Society in 1822, and received one of the Society's Royal Medals in 1826, the first year of award, but until May 1834, he had not attended to be formally admitted Babbage was, at the time, actively interesting himself in Dalton's presentation at Court, duly effected, it may be mentioned, though he did not go clad in levée dress The particular reason, however, for Dalton's stay in London was to give sittings to Chantrey, the sculptor, who had been commissioned by a representative committee to execute a statue of him Dalton recorded his visit to Chantrey thus He [Chantrey] took a profile as large as life by a camera lucida, and then sketched a front view of the face on paper He then gave me the next day for a holiday and told me I should see my head moulded in clay on Wednesday morning, at which time he invited me to breakfast I went accordingly and found, as he said, a head *apparently* perfect He said he had not yet touched it, the head having been formed from his drawings by some of his assistants He set to work to model and polish a little whilst I was mostly engaged in reading the newspaper, or conversing with him On looking right and left he found my ears were not alike, and the modeller had made them alike, so that he immediately cut off the left ear of the bust and made a new one more resembling the original At last he took a pitcher and blew a little water in my face (I mean the model), and covered my head with a wet cloth and we parted, he having desired me to bring Dr Henry and Dr Philip with me next morning to breakfast We went accordingly and found an abundant table, soon after Dr Faraday came in and we all went into the working room for a time At intervals we have a little amusement and instruction about our respective arts and sciences, and how we acquired our knowledge, etc, in which we vie with each other' (Henry, "Memoirs of John Dalton", 1854)

Sir Henry Holland in his 'Recollections" (p 212) remarks, referring to Dalton's early years, that he well knew that philosopher in his rude laboratory of bottles and uncouth apparatus at Manchester—an individuality in himself, apart from the Quaker garb he wore "

Wernerian Natural History Society, Edinburgh

In May 1834 the Society promoted and offered a number of honorary premiums, open unconditionally to all scientific workers The terms were incorporated in a circular notice, from which three examples are quoted —

(1) Twenty sovereigns, or a suitable piece of plate of that value for the best geological account, with a geognostical map, sections, and specimens, of the Three Lowthians, with as much of the neighbourhood as may be required for the elucidation of the districts To be given in against December 1835

(2) Ten sovereigns, or a piece of plate for the best natural and economical history of the fishes, marine, fluviatile, and lacustrine of the river district of the Forth To be given in against December 1835

(3) Ten sovereigns, or a piece of plate for the best account of the entomology of the Three Lothians, and river district of the Forth, with a collection of specimens, and map of the distribution of the insects To be produced against December 1836 (Memoirs, vol 7)

Societies and Academies

London

Physical Society, March 16 N Thompson The effective rotation temperature of the negative glow in nitrogen The effective temperature increases slightly with the pressure and current strength, and to a much greater extent with the temperature of the furnace surrounding the discharge tube At high temperatures it becomes less than the temperature of the furnace, and an explanation of this surprising behaviour is sought It is concluded that, in this particular case at least, the effective temperature is not identical with the gas temperature, though it depends in part on that quantity S S Watts and B J Lloyd Evans The measurement of flame temperatures in a petrol engine by the spectral line reversal method Until recently no satisfactory method existed for the measurement of the temperatures during combustion in a petrol engine The reversal of a spectral line provides a suitable method which shows that the maximum temperature in the engine cylinder persists for a longer period than the maximum pressure E B Moss An apparatus for the determination of the dew point The paper describes an optical system which uses diffraction by the dew droplets on a mirror and aids greatly the visual detection of dew formation Then follows an account of the application of this system to an automatic photoelectric apparatus for maintaining a mirror at the dew point

Dublin

Royal Irish Academy, April 9 R Southern Food and growth of brown trout in Lough Derg and the River Shannon The growth rate and size of the trout is definitely correlated with the composition of the rocks in the drainage area The water of Lough Derg and the Shannon is derived from limestone rocks and is alkaline, that of Lough Atorick comes from an area of Old Red Sandstone and peat and is acid The trout from Lough Derg and the River Shannon are large, quick growing, have a relatively long life and mature late Those from Lough Atorick are small, slow growing, have a short life and mature at an early age In the diet of the Lough Derg trout, 'mid water' food, consisting of *Cladocera* of the plankton and perch fry, forms a considerable part, but the Lough Atorick trout do not utilise this abundant food and live to a large extent on terrestrial insects blown on to the water The Shannon trout subsists almost entirely on bottom living organisms

Leeds

Philosophical and Literary Society, March 6 A Y Amin Note on a property of *Steinerian trihedra* H Frazer Subharmonic functions The author generalises the various results he has given recently concerning subharmonic functions R Whiddington E G Woodroofe and J E Taylor Note on the excitation of the neon atom by electron impact The changes of energy of the neon atom when bombarded by electrons of 120 volts are considered Three transitions from the ground state 2^1S_0 to the $3s$, $3p$, $3s_1$ states are observed The energy changes agree with those expected spectroscopically and the probabilities of the excitations are approximately in the ratio 16 4 5 J E Roberts Excitation of the nitrogen molecule by electron impact A brief survey is made of the question of the excitation of *diatomic molecules by electrons from the normal* to higher electronic states and two problems arise (*a*) the most probable energy loss of the exciting electron and (*b*) the probability of excitation of vibrational levels near to the most probable levels The case of the $X \rightarrow a$ transition in nitrogen is considered in detail The best available potential energy curves are obtained using the known spectroscopic data and the Morse formula Assuming harmonic vibration of the nuclei the relative probabilities of excitation of a few of the vibration levels of the *a* state are calculated These are in good agreement with the experimental results of Brindley though the most probable energy loss found by Rudberg is somewhat higher H M Dawson and W Lowson Velocity of the reaction between sodium chloroacetate and sodium hydroxide Measurements at 25° with the chloroacetate in considerable excess (1M $CH_2Cl\,CO_2Na$ + 0 1M NaOH) show that the bimolecular velocity coefficient remains sensibly constant until about 70 per cent of the alkali has disappeared but increases continuously in the later stages of the reaction This increase appears to be due to the simultaneous occurrence of three other reactions in which the products of hydrolysis are formed as a result of the interaction of the chloroacetate ion with water molecules other chloroacetate ions and glycollate ions respectively W Cameron Walker A portrait of Joseph Priestley and some of its associations E Marjorie Wray Structural changes in a woody twig after summer pruning The basipetal development of the cambium and the dependence of radial growth upon the developing bud results in the isolation of any part of the stem left above the topmost bud as a result of pruning as a snag This explains the pruning instruction always given, to prune immediately above a bud The rapid drying of the snag is very unfavourable to meristematic activity and the only evidence of cambial activity in the snag is the formation of cork phellogen round the schlerenchyma and also just within the protoxylem The healing of a well pruned stem is so complete that in a year or two the cut is almost obliterated and thus entry of disease is prevented Late summer pruning is followed almost immediately by the outgrowth of a single bud This is attributed to the fact that at this time of the year, when the water table in the tree is low and the air temperature is high, there is only sufficient water available to force one bud into growth

Paris

Academy of Sciences, March 26 (*C R*, 198, 1193–1280) H Lecomte Notice on Dukinfield Henry Scott *Correspondant* for the Section of Botany J Costantin, Magrou, Bouget and Mlle V Jaudel The experimental production of mycorrhiza in the potato André Blondel Some remarks on the use of headlamps on motor cars with a yellow beam Physiological reasons are given for the known favourable effects produced by the use of yellow glass with motor headlights in preventing dazzle A R Crathorne Moments of the binomial with respect to the origin Paul Lévy The *V* and *W* spaces J Géronimus Some extremal properties of polynomials the total variation of which is given King Lai Hiong The growth of integral functions of infinite order defined by a Taylor s series Julius Wolff The integral of a holomorph function with real positive part in a demiplane is univalent V Lalan An axiomatic definition of impulse and energy Edmond Brun The distribution of temperature in an insulating cylinder in rapid displacement in air P Lejay and Lou Jou Yi The general characters of the intensity of gravity in the north east of China The value of *g* diminishes as the distance west of the coast increases the results are indicated on a chart Georges Vaudet The time of discharge of a battery of condensers in a metallic wire The explosive volatilisation of a copper wire by the discharge has been studied by photography on a film with an interposed rotating mirror The time varied from 14 to 36 microseconds according to the conditions of the experiment N Thon The alternating current capacity of a non polarisable electrode H Hulubei and Mlle Y Cauchois Weak lines in the $K\beta$ spectra of the elements 42 (molybdenum) 45 (rhodium) and 47 (silver) R Guillien The absorption of liquid oxygen studied in great thicknesses In these experiments the absorption spectra have been studied in thicknesses of liquid oxygen up to 109 cm The results are discussed in connexion with previous work (McLennan Ellis and Kneser) Michel Kantzer The absorbing properties of chromyl chloride A list of lines in the absorption spectrum between the wave lengths 5428 A and 5016 A A Rousset The molecular diffusion of light in liquids the fluctuations of orientation of homopolar and heteropolar molecules Mlle C Chamié and M Haissinsky The rôle of age and concentration of polonium of solutions in centrifugation experiments The quantity of polonium precipitated on centrifuging (4 000 revs per minute) increases with age the amount diminishes as the concentration in polonium increases L Hackspill A P Rollet and Lauffenburger The double decomposition between ammonium nitrate and sodium chloride in the presence or absence of ammonia The experimental results are given graphically on a Löwenherz diagram A Damiens The expression of deliquescence and efflorescence Mlle Blanche Gredy and Léon Piaux The *cis trans* isomerism and synionic isomerism in the case of the crotyl derivatives P Brauman Some organic compounds of vanadyl Description of the preparation and properties of methyl vanadylsalicylate methyl phenoxyvanadyl salicylate vanadyl salicylate and vanadyl benzoate Alexis Tchitchibabine Phosphoric acid as a condensing agent The alkylation of phenols and of their ether oxides Georges Richard Contribution to the study of the α-chlorketones Edmond Urion A functional exchange between organo magnesium compounds and halogen derivatives Grignard has recently described a method of obtaining magnesium compounds the preparation of which is impossible by the ordinary methods, he ascribes the effects to the removal of a deposit from the surface of the magnesium The author gives an alternative explanation which he regards as more probable

R PAUL A method of preparation of the a alkyltetra hydropyranes RAYMOND FURON Preliminary observations on the existence at Damergou (Niger) of a Cretaceous fauna analogous with that of Djoua (South Algeria) HENRY HUBERT The circulation of atmospheric air at high altitudes above Madagascar R GAUTHERET Researches on the reduction of silver nitrate by the chloroplasts According to the author s experiments the action of light is necessary to start this reaction R ECHEVIN The evolution of the phospholipids of leaves in the course of the autumnal change of colour H COLIN and J CARLES Chemical affinities and hybridisation in the Iris G MALENÇON New observations concerning the etiology of Bayoud (disease of the palm) F DIÉNERT Contribution to the study of occult condensations (hydrogenesis) J LEGENDRE Longevity in the larvæ of a tree frequenting mosquito A GRUVEL Concerning some of the causes preventing the penetration of animal species into the Suez canal Besides mechanical effects due to the direction of the tides at the entrance the high salinity and drainage from oil refineries prevent the access of animal life to the canal GABRIEL BIDOU Protractor with index An instrument for measuring the amplitude of movements of limbs RAOUL LECOQ The possible existence in proteins of substances producing lack of food equilibrium W KOPACZEWSKI The gelatinisation of serum by organic acids Blood serum is rapidly converted into a transparent gel by the addition of lactic acid Other organic acids can produce the same effect but less rapidly C LEVADITI, MLLE R SCHOEN and A VAISMAN The mode of transmission and of propagation of the spirochætosis produced by *Spirochæta muris* and *Spirochæta morsus muris* J VERGE and H LANCE Swine influenza

VIENNA

Academy of Sciences February 1 GEORG KOLLER and KARL PÖPL A lichen substance containing chlorine This substance which contains about 4 per cent of chlorine appears to be chlorinated atranorin ALOIS ZINKE and OTTO BENNDORF Perylene and its derivatives (40) FRANZ HÖLZL and JOSEF KRAKORA Hexacyanoferro acid and ethyl alcohol ODOMAR GUGENBERGER The Cardita strata of Launsdorf in Central Carinthia and their fauna (3) Scaphopods and cephalopods (4) Lamellibranchs

February 8 GEORG HORNINGER The granite of Schärding (Upper Austria) This granite resembles in appearance and structure the Mauthausen type but is distinguished therefrom by the presence of large numbers of dark inclusions frequently rich in biotite GEORG BAIERSDORF Experiments on the limiting proportions of cadmium and palladium detectable spectroscopically in silver These proportions depend greatly especially with cadmium on the mode of excitation J D ALFKEN H BISCHOFF F MAIDL and ST ZIMMERMANN Hymenoptera (3) The occurrence of many species of insects on the islands of the Ægean Archipelago is recorded *Pheidole teneriffana* Forel previously met only in Northern Africa and Western Asia is found on Milos ANTON FUCHS and FRANZ KAUFEL Land and fresh water molluscs from Greece and the islands of the Ægean Sea AUGUST GINZBERGER The houses of the larvæ of the cicada *Fidicina chlorogena* Wlk ARTUR WINKLER Results of new [geological] studies in the middle and upper Isonzo region

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, May 28

ROYAL GEOGRAPHICAL SOCIETY at 8 30 —M Conrad Kilian Explorations Sahariennes (in French)

Tuesday, May 29

CHADWICK PUBLIC LECTURE at 5 30—(at the Royal United Service Institution, Whitehall S W 1)—Dr J B Orr The National Food Supply and Public Health *

Wednesday, May 30

ROYAL SOCIETY OF ARTS at 4 30 —His Excellency Mirza Sayyed Hassan Khan Taqizadeh Modern Persia

BRITISH SCIENCE GUILD at 9 30—(at the Royal Institution) Lord Rutherford Helium and other Rare Gases (Research and Development Lecture)

Thursday May 31

THE MEN OF THE TREES at 5 30 —Sir E Denison Ross Trees in Oriental Art and the Desiccation in the East

ROYAL AERONAUTICAL SOCIETY—(at the Science Museum, South Kensington S W 7)—Prof B Melvill Jones Twenty second Wilbur Wright Memorial Lecture

IRON AND STEEL INSTITUTE May 31–June 1 —Annual Meeting to be held at the Institution of Civil Engineers Great George Street Westminster S W 1

BOARD OF GREENKEEPING RESEARCH May 30 —Conference to be held at St Ives Research Station Sir John Russell Chairman

Prof R G Stapledon The Age of Scientific Practice

Official Publications Received

GREAT BRITAIN AND IRELAND

The Carnegie United Kingdom Trust Twentieth Annual Report, January December 1933 approved by the Trustees at their General Meeting held on Friday March 9th 1934 Pp vii+94+9 plates (Dunfermline Carnegie United Kingdom Trust)

Ancient Monuments of Great Britain List of Monuments prepared by the Commissioners of Works (to 31st December 1933) Pp 83 (London H M Stationery Office) 1s 3d net

The National Physical Laboratory Report for the Year 1933 Pp iv+264+11 plates (London H M Stationery Office) 13s net.

Stonyhurst College Observatory Results of Geophysical and Solar Observations 1933 with Report and Notes of the Director Rev J P Rowland Pp xxiii+42 (Stonyhurst)

OTHER COUNTRIES

Publications of the Dominion Observatory Ottawa. Vol. 10 Bibliography of Seismology No 20 October, November December, 1933 By Ernest A Hodgson Pp 339–368 (Ottawa King's Printer) 25 cents

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 86 Zoological Results of the Dolan West China Expedition of 1931 Part 2 Mollusks By Henry A Pilsbry Pp 5–28 + 6 plates. Review of the Planorbidæ of Florida with Notes on other Members of the Family By Henry A Pilsbry Pp 29–66 + plates 7 11 (Philadelphia)

An Introduction to Social Insurance Five Lectures delivered under the joint auspices of the University of the Witwatersrand Johannesburg and the Transvaal Workers Educational Association By Prof John P Dalton Pp viii+116 (Johannesburg University of the Witwatersrand Press) 1s

Carnegie Institute of Washington Annual Report of the Director of the Department of Terrestrial Magnetism (Reprinted from Year Book No 32 for the Year 1932–33) Pp 211–266 (Washington D C Carnegie Institution)

Straits Settlements Annual Report of the Director of Gardens for the Year 1933 By R E Holttum Pp 8 (Singapore Government Printing Office) 1 dollar

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CATALOGUES

Catalogus van diverse Bibliotheken verkooping 14–18 Mei 1934 Pp 96 (Leiden Burgersdijk and Niermans)

Zeiss Nachrichten Heft 6 April Pp 40 (Jena and London Carl Zeiss)

Watson s Microscope Record No 32 May Pp 24 (London W Watson and Sons Ltd)

Galvanometers, Photographic Recording Apparatus, Galvanometer Accessories (Galvo 33) Pp 24 (Delft P J Kipp en Zonen)

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Milk Supply in Relation to National Health

THE milk supply of Great Britain is engaging—as indeed it should—a large and increasing measure of public attention The difficulty of securing a remunerative price for milk is vexing more and more the minds of dairy farmers and of all who hold that a prosperous agriculture is *the corner stone of an enduring edifice of national* prosperity Prominent members of the House of Commons animated by a desire to increase the consumption of milk and to improve the health of the people are advocating that all children in State aided schools should receive a daily ration of milk Many of the medical profession whilst strongly in favour of this and other proposals designed to promote the drinking of more milk insist as guardians of the public health that milk must be *pasteurised* The recently formed Milk Board is preparing to engage in a campaign in which all the [illegible] of publicity will be used to promote the milk drinking habit and to these present and prospective efforts the *Times* is lending public spirited and invaluable support by opening its columns generously to correspondence from all quarters

The Committee of the Economic Council the appointment of which some time ago is proof of the Government s deep concern in questions relating to milk supply and consumption has completed its labours and its report will doubtless increase yet more public interest in a subject of which it is not possible to exaggerate the importance The moment is therefore opportune for a consideration of the problem of the national milk supply from a biological point of view

This consideration is to be justified on the ground that apart from its political and economic aspects the national milk supply is in its essentials, a biological problem At the very root of it lies the question how to secure to the nation a copious and constant supply of milk of the highest possible quality ?

The biologist will regard it as self evident that the health and strength of mankind depend more on milk than on any other nutrient agent whatsoever more perhaps than on all the other agents put together In milk health and strength have their origin and sustenance To this conviction all the new and rapidly accumulating knowledge of the many and decisive parts played by vitamins and by minerals in promoting growth and maintaining health lend unequivocal support It does more The new knowledge brings a new hope to the world The new-born hope sees the vitamins, the children of light, fully engaged in the service of man They prevail against the children of darkness The microbes that make so many maladies are vanquished one by one Mankind rejoices in an ever growing freedom from disease The new knowledge brings also as its first fruits a salutary uncertainty to science It is a new wine that will burst many old bottles The whole science of nutrition will have to be reconstructed on the basis of this knowledge, and the first step toward reconstruction must be a re investigation of the nutritive value of milk

At present no one knows how great that value is The mystical opinion is prevalent that milk is a composite principle an embodiment of good and evil It will be discovered presently how to make it wholly good The current opinion may be due to a simple cause Experiments carried out before it was possible to make a physiological analysis of milk—and it is even now not yet possible to make a perfect analysis of it—led often to conclusions which cannot be accepted as final because of the uncertainty of the composition of the milk with which they were made For, like Cleopatra, milk is of infinite variety It may be rich or it may be poor in health giving properties, and so all the old experiments which seemed so conclusive must be redone with material of known and high quality

Summer milk from cows grazed on pastures of young grass—the sweetest thing that grows—is rich in vitamin A and its precursor, carotene It has a comforting and agreeable flavour There is life in it Winter comes Growth of grass declines as the sun declines The lowing herd winds from the pasture to the byre Natural food gets scantier As winter pursues its sunless tedious course the vitamin A and carotene in the milk from the stall fed kine get progressively less, not to increase again until spring comes, and with the resurrection of the life of the pastures the dairy herd goes back to Nature for its food Can it be doubted that other equally and even more important seasonal variations in the composition and virtue of milk still await discovery seasonal variations in the amount of available bone building lime, of phosphates, iodine, other minerals and other vitamins! May not these seasonal deficiencies be the ultimate cumulative cause, generation after generation, of malnutrition and disease? They come at a time when their effects are doubly disastrous, in winter, when the sun itself grows pale and leaves health least fortified against attack

If, however, these things are true of the children who drink the milk, they must be true no less of the cow that makes it Like the pelican she gives her life's blood to feed the young In summer the sacrifice is light, but in winter how severe! May not bovine tuberculosis and other of the diseases which affect dairy herds be but the belated consequences of seasonal deficiencies of nutrition imposed by climate upon cattle? In the lowered state of resistance, pathogenic micro-organisms find their occasion, and a symptom of malnutrition comes to be regarded as a cause of disease 'Where the carcase is the eagles will be gathered together"

It is said that tuberculosis is rare or non-existent among cows of the Jersey breed so long as they stay in that fortunate island, but that when they go elsewhere they leave their immunity behind them If this be so, must not the resistance and susceptibility alike have their origin in nutrition? In the longer grazing season and in their fuller access to food from well managed pastures the cows find strength, but in a shorter season of less nutritive pastures they lose it, and in losing it become a prey to disease Whether the example be well founded in fact or not this at all events is indisputable the task of securing the best possible milk for the nation must be begun at the source—England's green and pleasant land, the green pastures Jerusalem, if ever to be builded here, must be built on them A defectively nourished people will never build it No man who travels in autumn time from the radiant valleys of Savoy to the sullen highlands of Auvergne will ever doubt again that health and happiness come to mankind by a tortuous route from heaven via the earth

The cultivation and management of pastures must serve as the basis on which a copious and consistent supply of rich milk must be established Those pastures can be made to yield all things necessary to health and strength The cows that graze them will give milk excellent in quality and delicious in flavour, a flavour which children will be eager to enjoy

The pleasant taste of milk and butter from cows fed on rich pastures is bound up with the presence of vitamin A and carotene, as though Nature were trying to coax the children of mankind to feed on what is good for them If therefore young England is to become a confirmed and heavy drinker of milk, palatability must be taken into consideration. For in this as in most matters the child has the last cry. Few mothers and fewer fathers dare impose their will on a reluctant babe.

This apparently trivial but really essential aspect of the subject bears on the problem of pasteurisation a thorny subject. The biologist who approaches it finds himself like Issachar "a strong ass couching down between two burdens". On one side is the weight of his respect for medical opinion on the other, the uneasy load of his belief that raw milk of high quality will prove superior to pasteurised milk. Accustomed to compromise by the baffling complexity of the phenomena with which he habitually deals, the biologist would accept pasteurisation of milk open to suspicion as a provisional and precautionary measure, provided that any enforcement of it were recognised explicitly as no more than precautionary and provisional. Nor would insistence on the safeguarding clause be dictated solely by doubt. It would also be inspired by the belief that search for other ways of preventing the carriage of pathogenic micro organisms by milk would find better ones.

Finally, the biologist cares not at all if the views which have been expressed find little acceptance so long as what is implicit in the argument is made to take immediate effect. It is that a great national effort must be made to discover means of securing to the people all the year round, plentiful supplies of the best milk that Nature and art can produce. The effort must not be confined to experts only. It must have "the help and advice of persons experienced in the right application of things". The effort must be initiated by the most powerful authority in the land—the Government itself. It must be directed to outlining and getting carried out a programme of comprehensive investigation extending from the pasture to the larder, and including dairy herd and farm water supply, cowman and milkman. There is old knowledge, massive and confusing, to be reviewed, and new knowledge to be won. The reapers are many but, though skilled, they are scattered. With these energies joined together the harvest would soon be plentiful.

Let the Government set up forthwith a small commission with large powers to lead the attack on a problem the solution of which would result in the rejuvenation of the race.

F K

Biological Philosophy

Allgemeine Biologie eine Einfuhrung in die Lehre vom Leben Von Dr Max Hartmann Zweite, vollständig neubearbeitete Auflage. Pp xii+792. (Jena Gustav Fischer, 1933.) 38 gold marks.

IN the issue of NATURE of December 17, 1932, we had the pleasure of reviewing a bold and original work on general biology by Prof Woltereck, and now we have before us a still longer and more elaborate work on the same subject by Dr Hartmann, who is a member of the staff of the Kaiser Wilhelm Institute for Experimental Biology at Dahlem. Naturally the subject is treated very differently by the two authors, for whereas Woltereck has attained world wide fame as a zoologist and embryologist, Hartmann's claims for distinction rest chiefly on researches on the Protista (Protozoa and Protophyta) and on the Thallophyta amongst plants. Then again, Woltereck came courageously into the battle, by asserting that in all living things there is a vitalistic factor regulating their actions which is not to be accounted for by the structure or mutual positions of their constituent molecules. Hartmann, on the contrary whilst repudiating materialism as a system of thought unworthy to be regarded as a 'philosophy , nevertheless holds that science can deal only with living things as lumps of matter it must argue 'as if' materialism were true.

Hartmann clearly recognises that human consciousness is the foundation of all our knowledge, that what we call 'matter' consists of presentations to this consciousness, and that most of the qualities with which we invest 'objects' do not inhere in them, but are given to them by the human mind. But there is the further difficulty, that only one consciousness is directly known to us, and that is our own. We infer a similar consciousness in our fellow men from their actions, that is, their movements, and if the view that the human race has grown out of some lower race of animals is correct, then it is impossible to deny something like consciousness, at least to the higher animals. Hartmann's limitation of the ambit of science to the study of material changes, if logically carried out, would condemn us to a philosophy of 'solipsism', which of all forms of philosophy is the most unpractical. We should be forced to attempt to explain the actions of our fellow-men by the chemical and physical structure of their bodies, leaving entirely out of sight their thoughts, feelings and desires, and an anthropology such as this would be worthy only of a madhouse. There can be no arbitrary restriction on the methods adopted by science: its aim is to establish general laws, as Hartmann himself says, to refer the individual to its place in the general scheme of things, and that method is to be preferred which gives consistent results and shows the fundamental similarity of widely differing living things.

We may perhaps illustrate the archaic quality of Hartmann's outlook by giving a brief account of the way in which he deals with the structure of Protozoa. He asserts that protoplasm is primitively a fluid, for he regards its semi-solid or 'gel' modification as secondary: he overlooks the fact that a fluid can have no organisation or definite arrangement of parts: its movements can only be controlled by its boundaries, and the only 'forces' which it can exert are those due to varying surface tension or increase in volume. So Hartmann is driven back on surface tension as the cause of amœboid movement, and still clings to the artificial amœbæ constructed by Bütschli out of oil drops impregnated with hygroscopic salts. Now the work of Jennings, Gray and Pantin has completely shattered this hypothesis and has proved that surface tension plays no part in animal or plant movements, but that the fundamental factor in all movement is the change from the sol to the gel condition or vice versa: that although the blastomeres of a rapidly dividing egg cell *look* as if they owed their shape and arrangement to surface tension, this is an illusion: what really happens in a dividing egg is the 'jellification' of its outer layer at the moment of division, followed by a partial solution between divisions.

It is true that Hartmann does mention in passing Pantin's work, but he asserts that Pantin's conclusion, namely, that in a moving amœba the endoplasm is pressed forwards by the contracting ectoplasmic sheath, does not apply to his (Hartmann's) amœbæ—but this is incredible. The great value of Pantin's work is that it brings pseudopodial movement into line with muscular contraction and shows that the fundamental nature of all animal movement is the same. Hartmann even endeavours to persuade us that the myonemes or contractile filaments of Protozoa and Cœlenterata, smooth muscles and cross-striated muscles, are essentially different things. This is unreasonable in view of the fact, for example, that the myonemes of *Hydra* are replaced by 'smooth muscle' cells in *Obelia* and that smooth muscle has actually been converted into striated muscle by subjecting it to prolonged and increasing tension.

Hartmann gives a large number of extraordinarily interesting facts about the reproduction of the lower organisms: these alone would render the book of very great value. He shows that sex, in the form of conjugation of nuclei, is ubiquitous: his account of sexual and asexual reproduction in *Chlamydomonas* is especially interesting. He arrives at the extraordinary conclusion that even when the conjugating cells appear precisely alike, nevertheless, by means of suitable tests, a male and a female partner can be distinguished, and that therefore the distinction between the sexes is not an 'adaptation' or division of labour gradually evolved in the more complicated organisms, but something fundamental involved in the very nature of life itself. As to the functions of sex itself, he comes to no very definite conclusion: he rejects the view that it is an arrangement made necessary by the gradual 'wearing out' of the vital processes, citing against this theory the experiments in which asexual reproduction has been continued for years *under carefully controlled conditions* without deterioration of the stock. But it seems to us that the significance of sex—as of all other biological phenomena—cannot be understood merely by the exhaustive study of one or two cases, but only by a broad comparative view of the matter, and what such a survey teaches is that sexual reproduction intervenes as a response to the onset of unfavourable outer conditions to which the product of sexual congress, that is, the zygote, is specially resistant. As the experience of all breeders shows that the vigour of the offspring is diminished when it is the offspring of two nearly allied parents, the old view that sex is a device for restoring vigour by enabling the deficiencies of one partner to be compensated for by the excellences of the other seems unlikely to be transcended.

As was to be expected from a member of the staff of the Kaiser Wilhelm Institute, Hartmann accepts wholly the Mendelian interpretation of variation and heredity. He does not see that the modifications which he is forced to make in Mendel's original statement are really the *reductio ad absurdum* of the whole theory. The Mendelian rules were founded on the results of crossing two varieties separated from each other by clear and sharply marked distinctions. Mendel himself expressly stated that he would have nothing to do with differences of 'a more or less character' Since functional differences, which alone are significant in evolution, are always of a 'more or less' character, it is probable that Mendel would have agreed with some of us in regarding the mutations studied by him, however interesting, as having played no part in the formation of species But when Hartmann invites us to believe that probably all mutations are due to the coincident action of a large number of 'genes' distributed at random, then it is obvious that any conceivable result obtained by the crossing of two races or species can be interpreted in accordance with the Mendelian rules, and such assumptions reduce the whole reasoning to a farce In justice, however, to Hartmann, it should be added that even he balks at the theory of Morgan that paired chromosomes break at various places and that pieces of one are incorporated in the other He asserts, and the most recent work bears him out, that the appearances relied on by Morgan, such as the apparent composition of the chromosome out of a linear series of granules, are optical illusions produced by the imperfect resolving powers of the microscope He further insists strongly that there is no such substance as 'chromatin'—that the chromosome is a morphological structure, not a chemical compound

In the concluding pages of his book, Hartmann conducts a polemic against Driesch as the leading vitalist He finds, as others have found before him when they have marched up to it, that Driesch's *position* is impregnable Hartmann admits that Driesch is right in saying that the developing embryo is not a machine, and that no mechanism founded on our present chemical and physical knowledge can be conceived to explain it , but he holds out vague hopes that Driesch's flank may be turned in the distant future by some as yet inconceivable development of 'colloid chemistry' This, in our opinion, is equivalent to a withdrawal from the walls of the fortress defeated But one of Hartmann's objections is worthy of further attention He says that Driesch forgets that the only reason for regarding the embryo as a "harmonic equipotential" system is that every cell has the capacity for developing into the whole In this sentence Hartmann crystallises the most profound discovery yet made by experimental zoology Whilst in some eggs, such as those of Annelida, separate blastomeres have limited powers, this is not due to the quality of the nucleus, which is always totipotent, but, as Driesch has explained, to the specialisation or 'stiffening' of the cytoplasm Now Brachet has shown that a frog's egg may be entered by six spermatozoa One of the spermatozoa unites with the nucleus of the egg constituting the zygote nucleus, the rest become independent nuclei All of them begin to divide and to organise the surrounding cytoplasm into cells What horrific monster will issue from this confusion ? The answer is a normal tadpole If this is not 'control', what is it ? And if it is control, does it matter with what term we label it, 'entelechy' or other ?

E W MACBRIDE

History of Engineering

The Newcomen Society for the Study of the History of Engineering and Technology *Transactions* Vol 11, 1930–1931 Pp xi+203+22 plates Vol 12, 1931–1932 Pp xii+142+13 plates (London Newcomen Society, 1932–1933) 20*s* net each Vol

THE Newcomen Society has but a comparatively small membership its members are so scattered that few are able to attend the meetings in London and New York, but in spite of this its sphere of activity is a large one, and its *Transactions* bear the stamp of authority The common interest of the members lies in the study of invention and craftsmanship, technological processes and engineering construction of all times Thus in the two volumes recently published are papers on the origins of windmills, Roman mining in Great Britain, fire extinguishing engines, railways and locomotives, straw handicraft, Hornblower and the compound engine, electric power supply in England and America mining in Cornwall and the Midlands and other matters, most of the memoirs being excellently illustrated The volumes also contain the annual reports, lists of members, accounts of summer meetings at Sheffield and Lichfield, notes on memorials to engineers, and lastly, Parts 9 and 10 of the valuable analytical bibliography of the history of engineering and applied science It has previously been pointed out that some considerable time elapses between the reading of papers and their appearance in the *Transactions* In the circumstances, this is largely unavoidable, but the publication of these two volumes within a few months of each other is a sign that efforts are being made to overtake the arrears The work of the publications committee is not a light one

The Society has been very fortunate in bringing to light original unpublished records , the value of such material is admirably shown in Mr J G H Warren's paper on "John Nuttall's Sketch Book" While one generally associates the locomotive with a few great names such as those of Trevithick, Blenkinsop, Stephenson, Gooch and others, to its gradual improvement in all its details a host of individuals have contributed One of these individuals was a smith, John Nuttall (1818–90) a craftsman whose work, Mr Warren says, is a lasting challenge to some educational theories of our time when a Master of Arts is held in higher esteem than the master of an art" The profound satisfaction Nuttall found in his daily tasks led him to add to a sketch in his note book Making this kind of work I was in my glore In early locomotives the wheels gave an infinite amount of trouble, and one can realise the pride with which Nuttall drew in his book a sketch of the Forst wrought iron wheel that was made ' Mr Warren reviews the whole history of locomotive wheel construction and in doing so establishes the fame of John Nuttall as a worthy not to be forgotten

The work of another such worthy is recalled by Mr F Bland's paper on John Curr Originator of Iron Tram Roads ' Born in 1756, from 1774 until his death in 1823 Curr was mineral agent to the Duke of Norfolk's collieries in Sheffield, and it was while holding this post that he used cast iron plate rails fixed to the wooden sleepers of a tramway James Outram made the rails, but his name has nothing to do with tram roads , as is often supposed

Among other papers read before the Newcomen Society in 1931 were two on early electricity supply undertakings, Col R E Crompton dealing with The First Installation of House to House Electricity Supply in the United Kingdom ', and Mr G A Orrok with "Pearl Street Station, the First Central Station in the World ' Mr Orrok's paper was based largely on the manuscript left by Dr J W Lieb (1860–1929), who had worked at the Pearl Street Station directly under Edison These papers were read in London on April 15 and in New York on April 16, and created considerable interest, the discussion in New York eliciting some interesting reminiscences from Mr F J Sprague, who as a midshipman in the U S Navy attended the Electrical Exhibition held at the Crystal Palace in 1882 and was secretary to a jury including Fleeming Jenkin, Grylls Adams, Abney, Edward Frankland and Horace Darwin In the discussion in London it was recalled that the *Engineer* in 1882 said that "probably no one has done more to make the electric light a popular success than Mr R E Crompton'

Another side of engineering history is represented by the biographical sketch by Prof J K Finch of "John B Jervis, Civil Engineer" (1795–1885), ' who did more than any other man to make engineering in America a profession", and Mr H W Dickinson's paper on 'Jolliffe and Banks, Contractors", the latter paper being suggested by the centenary of the opening of London Bridge, for which they were the contractors The Dictionary of National Biography" says little about Sir Edward Banks and nothing about his partner, the Rev W J Jolliffe, yet they were both remarkable men carrying out many important public works, and ' indeed they were the foremost firm of contractors in an age of big achievements" Banks began life in the North, building dykes, making canals and cutting tunnels Going to Surrey, he assisted in laying down the Surrey Iron Railway and then, joined by Jolliffe, secured contracts in various parts of the country Their most notable constructions included Waterloo, Southwark, London and Staines Bridges and Sheerness Dockyard They both died in 1835, Jolliffe being buried at Merstham and Banks at Chipstead close by One of the results of the reading of Mr Dickinson's paper was that through the generosity of Mr J J Edwards, chairman of the Bridge House Estates Committee of the City of London, the fine tomb to Banks at Chipstead has been rescued from neglect and thoroughly reconditioned This is only one example of the preservation of a monument through the action of the Newcomen Society

Fossil Vertebrates

Vertebrate Palæontology By Prof A S Romer Pp vii+491 (Chicago University of Chicago Press , London Cambridge University Press, 1933) 26*s* 6*d* net

THIS well printed textbook has been carefully prepared, and will be welcomed by both zoologists and geologists The letterpress begins with a brief recapitulation of some elementary geology to refresh the memory of the zoologist , while each chapter is prefaced by enough anatomy and zoology to enable a geologist to appreciate the meaning of his fossils Though nearly all the illustrations are taken (with acknowledgment) from other authors, most of them have been re-drawn in uniform style, and a few have been improved for the student by making them more diagrammatic. The whole bears the impress of a teacher who is actually engaged in research and has himself made many contributions to our knowledge of the fossil vertebrates about which he writes. The book is well up to date, as shown by the beautiful sketches of the restored skull of the oldest known amphibian, *Ichthyostega*, which was discovered recently in Greenland.

Prof. Romer sometimes enlivens his descriptive matter with speculations and suggestions about various possible courses of evolution. At the outset he favours the theory that the echinoderms and the vertebrates had a common ancestry. Next he speculates as to why so many of the earliest vertebrates were heavily armoured when the jaws of all their kin were feeble. He thinks they may have been thus protected against the contemporary aquatic scorpion-like invertebrates, the eurypterids, which would doubtless have fed on them. In the chapter on birds he points out how at the beginning of the Tertiary period there was real rivalry between mammals and running birds for the possession of the land which was left vacant by the disappearance of the dinosaurs. The course of evolution, indeed, might have been different if birds had succeeded in the conquest.

To emphasise the relationships of some of the great groups, Prof. Romer also makes an innovation. Instead of treating all the earliest members first, he relegates to the end those forms which seem to be the direct ancestors of the next higher grade. The crossopterygian and dipnoan fishes, for example, are placed after the teleosteans so that they may be discussed immediately before the amphibians. At the end of the reptiles the dinosaurs are next to the birds, which are said to be "so close to the archosaurians that we are tempted to include them in that group". The Theromorpha, or mammal-like reptiles, are removed from the other reptiles and placed between the birds and mammals.

The volume concludes with a bibliography and a synoptic classification of vertebrates, in which the geological and geographical range of the extinct genera is indicated. The localities of the various fossils, however, are always only vaguely given, and we think that Prof. Romer would have made his valuable work still more useful, at least to advanced students, if he had recorded the sources of the chief specimens more precisely.

A. S. W.

University Omnibus

The Yearbook of the Universities of the Empire, 1934. Edited by Sir H. Frank Heath. (Published for the Universities Bureau of the British Empire.) Pp. 24+xxxii+1010+vi. (London: G. Bell and Sons, Ltd., 1934.) 15*s*.

THOUGH the crisis of distribution may not be so intense in the world of knowledge as in its commercial counterpart, it is yet sufficiently well marked to make us grateful for anything that serves to lessen the labour involved in its acquisition. There are, so we are informed by the preface of the 1934 Universities Yearbook, seventy universities within the confines of the British Empire—and each takes a growing interest in the affairs of the other. This interest has been forced upon them by such facts as that in 1933–34 (excluding Trinity College, Oxford, from which no return was received), there were 5,180 students from other countries in the universities and university colleges of Great Britain and Ireland.

Like a pudding in the eating, the measure of the value of a reference book lies in its use. It is hard otherwise to appraise it, but this being the last number to be produced under the editorship of Sir Frank Heath, who retires from his post of honorary director of the Universities Bureau of the British Empire this summer, it may not be amiss to note some of the changes that have taken place in the make-up of the 'Yearbook' during his five years of office.

If a reference book is to be judged by its index, the 'Yearbook' has a good claim to praise. To prepare an adequate index of names, it is true, is but a matter of care; but the compilation of a general index is another matter. Here, if anywhere, the skill and knowledge of the editor is displayed. Compared with what it was in 1929, the general index of 1934 is a vast improvement.

Other alterations have been introduced by Sir Frank into the appendixes, of which there are now thirty. For example, the section dealing with professional bodies has been considerably enlarged. This year there has been collected in one place (Appendix XXII) on a uniform system information dealing with admission to the several universities of Great Britain and Ireland. It is a damning indictment of unregulated effort. It is a wonder that any student has the temerity to attempt entrance, so diverse are the exempting examinations, special exemptions, special regulations and the like.

Very valuable collections of information are to be found in Appendixes XXIII and XXIV The former gives particulars of the less 'limited' aids to advanced work such as postgraduate scholarships, fellowships and research grants (mostly tenable by British subjects) in Great Britain, the Dominions and foreign countries The latter gives a short account of the purpose of the more important centres of scientific research and information within the Empire

If one criticism and one suggestion be permitted, it is that though science is adequately covered, there is no reference whatever to archæology, history, economics, or, in short, the social and humane sciences There should be

With advantage, too, the section devoted to Industrial Scientific Research (pp 849–859) might be developed into something as big as the American National Research Council's publication on industrial research laboratories Admittedly it would add fifty more pages to the 'Yearbook", but it would be worth while Teachers want to know where they are likely to be able to place promising students , or what firms are prepared to admit advanced students and research workers and under what conditions , and lastly, such an amplification would have the intangible but very real effect of bringing industry and scholarship closer together

The "Yearbook" is essentially a reference work purchased by institutions, and it is not intended for armchair reading Price and bulk, therefore, need not cause too great anxiety to the editorial staff Indeed the fuller the information, the greater the value and the greater the possible sales In any event, even now, every university, every college and every British embassy and consulate ought to have a copy as a matter of course Its uses are infinite, and abroad it would help to bring foreign students to England and into closer touch with our learning and culture, and thus make for better international understanding

The publication of the "Yearbook" is one of the primary objects and justifications for the existence of the Universities Bureau of the British Empire Sir Frank Heath will be able to retire, not to inactivity we hope, secure in the knowledge that the "Yearbook" has grown in scope and usefulness under his care, and that his successor will have the incentive of successful achievement of high aims

Short Reviews

(1) *Secret Ways of the Mind a Survey of the Psychological Principles of Freud, Adler and Jung* By Dr W M Kranefeldt Translated from the German with a Preface by Prof Ralph M Eaton Pp xl+188 (London Kegan Paul and Co , Ltd , 1934) 6s net

(2) *A Survey of the Science of Psychology* By Prof J R Kantor Pp xvii+564 (Bloomington, Ind The Principia Press, Inc , London Williams and Norgate, Ltd , 1933) 16s net

We consider these two books together, because, although they are scarcely comparable in any other sense, they both take up a definite attitude as to scientific method Prof Eaton, the translator of the first book, points out that the official psychology, craving for the methods of the exact sciences, and concentrating on what can be measured, has forgotten its original subject, which is human nature This is one reason why the unofficial psychology of Freud and Jung and Adler has swept over Europe and America Dr Kranefeldt's monograph, with an introduction by Jung himself, may be recommended as an excellent critical survey of this movement

Prof Kantor also aims at a truly scientific method, but he is too wise to be content with quantitative measurement, with the statistics of learning curves and intelligence tests, when human nature at large, with its joys and its sorrows, its loves and its ambitions, is the real subject of investigation Also, though he admits that the behaviouristic is more scientific than the mentalistic psychology, he is no behaviourist His organismic' or interactionist point of view, he claims, enables him to steer clear of the mistakes of both these other schools We believe he justifies his claim, and we are quite sure that his conception of psychology has enabled him to present a very broad and suggestive treatment

The Organism of the Mind an Introduction to Analytical Psychotherapy By Dr G R Heyer Translated by Eden and Cedar Paul Pp xiii+271+37 plates (London Kegan Paul and Co , Ltd , 1933) 15s net

Mind and body are not two distinct spheres of being Their mutual influence is shown, among other phenomena, by neuroses which occur when the psychogenic disturbances from which a patient suffers manifest themselves chiefly as impairments of bodily functions In elaborating the experimental foundations of this view, the author attempts to show the existence of a series of psychophysical 'cycles' or 'spheres' in which life variously and progressively discloses itself as it moves from the primitive to increasingly differentiated phases and forms A description of the chief psychotherapeutic methods completes the technical exposition of the volume

Besides the qualified opinions of the author about the various points raised, the book will be found most interesting and useful as an introduction to the new psychological theories such as autosuggestion, analysis of the unconscious, psychoanalysis, individual psychology and analytical psychology, which have done so much in bringing psychology and medicine together The unitary view of life adopted by the author, which he rightly traces back to the pre-Socratic thinkers, gives an added interest to his general exposition

Leçons sur les fonctions univalentes ou multivalentes professées à la Sorbonne Par Prof Paul Montel Recueillies et rédigées par F Marty, avec un Note de Henri Cartan (Collection de monographies sur la théorie des fonctions) Pp iv+159 (Paris Gauthier-Villars et Cie, 1933) 40 francs

THERE are two methods of studying analytic functions The first consists in examining the points where the function becomes peculiar—its singularities These points characterise functions of the same group and at the same time give them individuality The second consists in examining properties at ordinary points—the region of regularity This interesting book adopts the second method The author seeks to classify functions according to their order of multivalence, that is to say, the number of times which the function takes the same value The univalent functions are particularly important since they are fundamental in the theory of conformal representation A univalent function when substituted for the variable leaves the order of multivalence invariant

The book is founded on a course of lectures given at the Sorbonne by Prof Montel and has been ably edited by M Marty, who has made many original contributions In an appendix, M Cartan considers the possibility of extending the idea of univalence to functions of several variables

Functions of a Complex Variable By Prof Thomas M MacRobert Second edition Pp xv+347 (London Macmillan and Co, Ltd, 1933) 14*s* net

THIS second edition of this useful book will be warmly welcomed The theory of functions of a complex variable plays an increasingly important part in the applications of mathematics to physical problems The student who desires to make these applications without delving too deeply into abstract theory will find here just the material which he requires, clearly set out and with sufficient rigour for his needs Bearing in mind the difficulties of the beginner, Prof MacRobert has tempered the arithmetical approach to the subject with a wise admixture of geometrical intuition, and has thereby succeeded in producing a book which may be easily consulted on any particular point such as contour integration, special functions, or the linear differential equation of the second order The new edition differs mainly from its predecessor in the addition of appendixes on the hypergeometric function, Legendre functions and Fourier integrals

The New Psychology and Religious Experience By the Rev T H Hughes (Halley Stewart Publications, 2) Pp 332 (London George Allen and Unwin, Ltd, 1933) 10*s* 6*d* net

IT can be safely said that religion has now weathered the storm of scientific criticism If it has beaten back the forces of materialistic philosophy, it is because of its reliance on the reality of religious experience In this very able book Principal Hughes defends that experience against the disintegrating criticism of the new psychology, especially of behaviourism and psychoanalysis He discusses the origin and meaning of religion in the light of these systems, and shows that God and conscience are not mere projections of the self, but independent realities which give a real value to religious experience in general and to Christianity in particular The expert way in which the various problems raised are treated is a tribute to the ability of the author and to the great importance of his subject T G

(1) *La géométrie à la portée de tous* Par J Poirée Pp 117 (Auch Imprimerie Cocharaux, 1931) 20 francs
(2) *L'Arithmétique à la portée de tous nombres entiers, fractions, calculs approchés* Par J Poirée Pp v+97 (Paris Gauthier Villars et Cie, 1932) 25 francs
(3) *L'Algèbre et la trigonométrie à la portée de tous* Par J Poirée Tome 1 *Calcul algébrique et équations* Pp v+57 15 francs Tome 2 *Etude de la variation des fonctions* Pp vi+44 15 francs (Paris Gauthier Villars et Cie, 1933)

THESE four little books represent the limit of simplification and are intended for those who have never studied mathematics at all For these they are probably too difficult To the teacher of the elements they might offer some useful ideas of simplified exposition

Vorlesungen uber Boden Mikrobiologie Von Prof Dr August Rippel Pp viii+161 (Berlin Julius Springer, 1933) 6 90 gold marks

THIS handy and accurate book is packed with facts concerning a wide range of the bacteriology of soil and water It would make an excellent foundation for a course, though its value to the student is reduced by the absence of any references except to textbooks The names of many authors are given, but most of them are Central European The language and planning of the book are clear, and the work can be cordially recommended

Physics and the Public Mind

By PROF. HERBERT DINGLE, Imperial College of Science, South Kensington

AN epoch in science is invariably followed by a general change of attitude towards life as a whole, which is none the less profound because it lacks the dramatic suddenness of its precursor. Newtonian mechanics had no direct bearing on vulgar hopes and fears, yet the popular reaction to the appearance of a comet in the eighteenth century was not that of the sixteenth, even among those who knew nothing of gravitation. Organic evolution was not obviously concerned with sociology, yet to Spencer the word 'progress' meant something other than it meant to Rousseau. No scientific idea lives to itself or dies to itself.

The responsibility which this fact lays on the shoulders of the man of science weighs not on his researches but on his treatment of their results. By the very essence of his calling he is consecrated to truth, and he must know all her ways, whatever their effect on human institutions and beliefs. But, by the same token, he must see that his report on what he finds does not mislead; above all, that it does not contain a denial of the spirit of research itself.

> For I say, this is death and the sole death,
> When a man's loss comes to him from his gain,
> Darkness from light, from knowledge ignorance.

Difficult as it must always be properly to estimate current events, it is clear beyond question that the post-War years have seen a development of fundamental physical ideas such as history has rarely recorded. Already the theoretical physicist of middle age, if he has time to muse at all, contemplates the outlook of his youth with something of the feelings with which he regards medieval thought. It is only fitfully that he realises, with a mild shock of surprise, that this archaic attitude was once natural to himself and is still part of the mental equipment of most of "that section of his contemporaries which is called the public". On the world at large the impact of the new ideas must necessarily work more gently and slowly, but no less inevitably. Sooner or later, social institutions, literature, art, religion will reflect the change, and it is not too early to inquire how the public mind is reacting to the scientific revolution itself, for on that reaction will depend the more subtle developments in the various fields of practical human interest.

At first sight the omens are pleasing. Thanks largely to broadcasting and the great skill in exposition shown by certain of our physicists, popular attention is given to things scientific probably in greater measure than ever before. Not only so, but the recognition is general that science has something vital to contribute to the various departments of thought, feeling and action, and there is a genuine desire to know what that contribution might be. Superficially this is all very satisfactory.

When we look deeper into the phenomenon, however, grounds for misgiving appear. The remarkable fact that books of science have become best sellers admits of two possible explanations: either the most widespread desire of the public has changed, so that it is now for scientific thought instead of thoughtless diversion, or else books of science have changed so as to provide thoughtless diversion instead of scientific thought. Unfortunately the latter alternative appears to be nearer the truth.

There was a time when the writer of science for the public demanded considerable mental effort from his readers, as a tribute befitting the dignity of his subject. He showed them the steep and thorny way to heaven. Nevertheless he led them there if they were willing to follow him. To-day we are only too familiar with the primrose path to the everlasting bonfire. Writers such as Ball and Lockyer not only described the achievements of science; they indicated also the steps towards those achievements, appealing to reason to approve the course as well as to admiration to applaud the goal. The modern successors of these men are too prone to present the achievements, made alluring by their plumage of paradox, and to prevent access to the steps by a mysterious guardian who, finger on lip, whispers in hushed tones the magic word, Mathematics. The consequence is inevitable. The reader not only enjoys the fun, but also feels at liberty to claim science in support of whatever philosophical or religious dogmas he may hold, paradox lending itself readily to favourable interpretation by contradictory creeds. Any scruples of conscience he may feel at taking this royal road to learning are allayed by the assurance that he need not think for himself since in any case the argument is beyond him. Small wonder that the age when science is most difficult is the age when it is most popular.

To make the point definite, let us concentrate attention on one of the most prominent elements of the new nescience—the doctrine of indeterminacy. It is widely preached that modern science is essentially indeterministic, and that therefore we may not only believe in human free will if we like—which, of course, we could always do—but also claim scientific support for it. This idea, emanating from men of science with the highest credentials, has spread, both directly and through various grades of intermediary expositors, to the pulpit, the newspaper and the market-place. Authority for the idea is everywhere; evidence for it, however, is far to seek. As an example we may cite an earnest little book recently written by a doctor of science with the object of showing the plain man the trend of modern science and philosophy. "The work of Dirac," he writes, "suggests a somewhat transcendental nature of matter, while that of Heisenberg is particularly significant because it has knocked the bottom out of the idea of predestination, put probability in its place, and shown that there is even a physical basis for the belief in free will as a factor of existence." When we seek for evidence for this remarkable statement, all we meet with is the following: "The mathematicians are among the most trustworthy of intellectual guides. Physics is essentially a mathematical subject, and over some of the ground we have to traverse the experimental physicist will still accompany us, but eventually we may have to trust the mathematician alone." When a doctor of science (who, it may be said, implies that he himself is unable to follow the mathematical arguments) can write in these terms, we may wonder whether the twentieth century differs intellectually from the sixteenth except in the substitution of the mathematician for the medieval philosopher.

The protest will at once be raised: 'What can one do? Theoretical physics is indisputably beyond expression in popular terms, and is one to keep some of the greatest intellectual adventures of history as a secret possession because they cannot be described in their fullness without mathematical language?' The reply is that the evil does not lie in the incompleteness of the presentation—that must always exist—but in its character. Conclusions are presented as mathematically demonstrated which mathematics has not only not demonstrated but is also inherently incapable of demonstrating. Mathematics is thus portrayed as the magic wand of the few instead of the concentrated reason of all. Once the supreme expression and inspired Word of Reason, it has become an indulgence, granting absolution for the wildest excesses of irrationality. Instead of being a mental tonic, its very name has become a mental opiate, and elementary fallacies which a generation ago would have been detected by the most ordinary of thinkers, now deceive the acutest minds, which lie bemused under its spell.

To exemplify this it is not necessary to take the more outrageous application to human free will, which in actual fact has not yet been shown to bear any relation at all to physics. We can go deeper and look at the purely inorganic indeterminacy. The basic expression of this doctrine is to be found in Prof. Dirac's "Quantum Mechanics": "When an observation is made on any atomic system that has been prepared in a given way and is thus in a given state, the result will not in general be determinate, i.e., if the experiment is repeated several times under identical conditions several different results may be obtained." Let us see how this astonishing conclusion has been reached.

The whole of quantum mechanics, of which this is a part, has been built up as an attempt to explain the results of experiment. Now not only is it true that not one experiment has ever been repeated several times under identical conditions without the same result having been obtained (allowing, of course, as has always been done, for the small errors inevitable in human experiment), but the very statement which Dirac makes is based on this constancy. It will not do, for example, if he can say merely that a spectrum produced in Prof. Fowler's laboratory on such and such a date contained a line of which the wavelength on the following day appeared to Prof. Curtis to be so many units in terms of a scale which some years before had been found by an employee of Messrs. Hilger to bear a certain relation to a *still earlier state of the standard metre*. Unless he can say quite generally and definitely that the wave length of $H\alpha$ is that and nothing else, the whole system of quantum mechanics collapses for want of evidence. If, then, the conclusion quoted is true it automatically knocks away its own support and all reason for believing it vanishes.

This argument is very simple, and it is irrefutable. It makes no appeal to the algebra of matrices or group theory, but rests on the elementary logical principle that an argument whose conclusion violates its premises cannot be sound. Twenty years ago it would have occurred at once to any person of ordinary intelligence, but to-day what do we find? Half the world proclaim with joy that at last the most exact of sciences has established the freedom of the will, while the rest sit in bewildered silence, restraining the protest they long to make from fear that mathematics might have ways of disproving the obvious. The spectacle would be amusing if it were not so serious.

Let us understand the position clearly. It will not do to scoff at quantum mechanics and look upon the modern developments of physics as a malignant growth from which science may recover under the surgeon's knife; they are, on the contrary, a mutation in the authentic line of development of thought. Dirac is not the fool he may superficially appear; he possesses one of the very greatest minds our age has produced. The fault is not that we are living in an age of darkness, but that the brilliance of the time is making us blind, that loss comes to us from our gain and ignorance from our knowledge. What is wanted is a reformulation of the philosophical foundations of science, so that sense shall not have to express itself in nonsensical terms. The philosopher may give it to us but there is more hope from the man of science, for in the present situation it is not so difficult for him to acquire sufficient philosophical knowledge and acumen as it is for the philosopher to familiarise himself with physics. But the manner of its coming is of minor importance; the great thing is to get it.

We are not unfamiliar with this demand or with attempts to satisfy it, but there is little sign that the real desideratum is properly understood. It is not sufficient to impeach Victorian assumptions and declare how much wiser we are now. The new philosophy must not merely reveal the falsity of the old; it must embody all its truth. To resort once more to imagery, the relation of what we are offered to what we need is somewhat as follows In surveying the physical landscape we have discovered certain facts which we cannot fit into the same plan as the more familiar ones every attempt to co-ordinate them involves us in absurdity There are two ways out of the difficulty The first, which appears to be the only one attempted—or, at any rate, popularised—so far is to assume that the landscape *is* absurd, and that instead of marvelling that we cannot make a rational conception of it, we should rather pity our former inability to see that absurdity is the essence of Nature The second way, which at least seems worth trying, is to change our point of view until the spectacle again becomes coherent To do this is not easy it is much pleasanter to lie in a bed of chaos and smile at our folly in thinking reason worth while But the time may come when we shall regret such a choice

It is a question for the specialist now, but in a few decades it will be a matter of universal importance, for the abstract thought of one generation, operating unperceived by the majority, directs the practical activities of the next It is not merely scientifically indefensible, it is socially tragic when a tremendous forward leap in human thought, about which the public is curious to a degree never before witnessed, is represented as a negation, by an unintelligible formula, of all that has been proved trustworthy in the past, when a man like Sir Arthur Eddington, who is responsible for the most valiant attempt yet made to form a positive unity of the new ideas, can for public instruction give as a summary of the whole situation the vague and inaccurate phrase, "Something unknown is doing we don't know what", when Sir James Jeans can so far forget his own admirable work as to write, "Heisenberg now makes it appear that Nature abhors accuracy and precision above all things", and when the only means the truth seeker has of detecting the falsity of these statements—namely, the exercise of the reason with which he is naturally endowed—is made impotent by the suggestion that mathematics, which he has no time to learn, has discovered how to prove the illogical There is here a situation far more serious in the long run than many of the problems which agitate public life to-day

Freedom of thought may be attacked in two ways Many recently have been moved to protest against the use of external force for this purpose But, regrettable as such control is, it cannot by its very nature constitute a real limitation Stone walls do not a prison make, and history has shown that the blood of the martyrs is the seed of the Church Infinitely more dangerous is the menace to thought from thought itself When, in the name of science, criticism is not chained but drugged, and unreason, in robes *not its own*, receives the homage meant for reason, thought is enslaved indeed Those who are wise enough to see how the social life of a people is related to its mental state will scarcely contemplate the future with equanimity

Diet and Dental Disease in Man

IT is now well established that there is an intimate relationship between the structure of the teeth in animals and the composition of their food supply, as well as between the latter and certain forms of dental disease The work of Mrs Mellanby on these problems has already been referred to in these columns (NATURE, 125, 604, 1930 127, 977, 1931) The results of these researches led naturally to an investigation of the problem of dental caries in human beings, along original lines, with the view of determining whether a similar relationship between diet and structure and disease held here also An interim report of a clinical trial by the Committee upon Dental Disease was issued in 1931 (NATURE, 129, 83, 1932) and is now followed by the full account of Mrs Mellanby's experiments upon the effect of diet on dental structure and disease in man*

An account is given first of normal and abnormal development and structure of the teeth by normal is meant the perfect structure which can be obtained in animals receiving vitamin D and a sufficiency of calcium and phosphorus The normal tooth is creamy white, smooth and shiny in appearance, the enamel is relatively thick and regular in outline, with a more or less regular, systematic arrangement of the prisms and comparatively little pigmentation The dentine is relatively thick and shows no poorly calcified areas (or interglobular spaces) Such spaces are rare in animals living under natural conditions, but in civilised man, who lives under artificial conditions, their presence is the rule rather than the exception Teeth can be graded according to the surface character of the enamel, even while still in the mouth good correlation was found between surface texture and minute structure in the shed or extracted teeth submitted to microscopical examination, so that it is possible to infer the histological structure of teeth while still in the mouth

In a collection of more than 2,000 shed and extracted teeth, it was found that, whether assessed by surface or histological examination, the majority of the deciduous teeth were defective (hypoplastic) in structure, the incisors being the best and the second molars the worst formed Teeth collected from private sources were better calcified than those from public elementary school children The majority of the permanent teeth were also hypoplastic The teeth of two groups of children were also examined, the first in a hospital for surgical tuberculosis (1,684 deciduous and 1,453 permanent teeth) and the other in cottage homes (12,807 deciduous and 14,078 permanent teeth) 21 per cent of the deciduous teeth of the latter group and 7 per cent of those of the former had no defects , 32 per cent of the former's but only 5 per cent of the latter's were very hypoplastic As regards the permanent teeth, 1 per cent were normal in the hospital children and 24 per cent in the cottage homes children, 43 and 8 per cent being very hypoplastic respectively Histological examination indicated that in the majority of deciduous teeth the part formed before birth was well calcified, the defects beginning to form how ever, soon after birth

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* Medical Research Council. Special Report Series, No 191 Diet and the Teeth, an Experimental Study Part 3 The Effect of Diet on Dental Structure and Disease in Man By May Mellanby Pp 180. (London H.M Stationery Office, 1934.) *5s* net.

As regards caries, of which three degrees were arbitrarily recognised, it was found that 27 per cent of the deciduous teeth of British children were free from the disease, while 42 per cent were very carious 67 per cent of the incisors but only 4 per cent of the second molars were caries free , 10 per cent of the incisors and 63 per cent of the second molars were severely affected The teeth collected from private sources were less carious than those of the children from public elementary schools Caries was also more prevalent in the children in hospital than in those in the cottage homes 47 per cent of the teeth in the former group and 73 5 per cent of those in the latter were free from the disease Caries was extensive in 22 per cent and in 7 per cent respectively in the two groups 68 per cent and 83 per cent of the permanent teeth were healthy The incisors and canines were the least and the first molars the most affected

The data given above suggest that there is a close relationship between the structure of the teeth and their liability to caries It was found on analysing the figures more closely that, of the deciduous teeth diagnosed as normal by surface appearance or by the histological structure of the enamel or dentine, 77–83 per cent were free from caries, whilst 2–10 5 per cent were severely affected On the other hand, of those diagnosed as very hypoplastic, only 7–9 per cent were free from caries, 60 5–73 per cent being severely affected The same general association holds also in the case of the teeth examined in the mouth, including the permanent teeth Mrs Mellanby concludes "It can therefore be stated as a general hypothesis that there is a close direct association between structure and caries "

Only in 11 2 per cent of the deciduous teeth was no direct association found, 5 1 per cent being too carious for the structure and 6 1 per cent less carious than might have been expected from the structure Examination of the sections for the presence of secondary dentine and its structure when present showed that teeth of poor structure yet free from caries had well calcified dentine, whilst the latter was usually imperfectly formed when caries appeared in a tooth originally well formed In other words, the defensive reactions of the teeth after eruption play a part in the association between structure and caries Only about 2 per cent of the 1,500 teeth examined were gross exceptions to the two hypotheses of direct association between structure and incidence of caries and that there may be a change in the resistance of the teeth after eruption which is indicated by the character of the secondary dentine

The next step was the experimental confirmation of the relationship between diet and structure and so between diet and caries in human beings Four successive investigations were made in a Sheffield Hospital for surgical tuberculosis and afterwards two concurrent tests on children in the Birmingham Cottage Homes, one lasting for two years and the other for a year and a half The ordinary diets given the children were those commonly considered adequate in all respects the modifications made were additions of oatmeal, olive oil, cod liver oil or radiostol (irradiated ergosterol), and milk, butter and eggs, or removal of oatmeal and other cereals The energy value, fat, protein and carbohydrate content, as well as the amounts of calcium and phosphorus present, were kept as constant as possible in the different diets , on the cereal-free diet the carbohydrate was reduced and the fat proportionately increased In the Sheffield investigations, considering only the children less than six years old (as the average age in the earlier investigations was about eight years), it was found that the average number of teeth per child showing initiation or spread of caries was reduced from 5 0 on the diet containing no extra vitamins A and D, but with increased oatmeal, to 0 37 on the cereal free diet with addition of cod liver oil and radiostol solution daily The average number of teeth per child in which caries showed hardening was increased from 0 2 to 4 7 The Birmingham results bore out those previously obtained in Sheffield and showed that vitamin D is an important factor in checking the initiation of fresh caries, diminishing the spread of old caries and arresting the infective process in many carious teeth

Following the discussion of the experimental evidence in favour of the thesis that diet and dental disease are intimately related through the variations in structure of the teeth which can be produced by changing the diet, the report considers the racial distribution of caries, since the thesis ought to be capable of explaining the relative immunity or susceptibility of races and communities in various parts of the world A review of the available evidence suggests that the main conditions responsible for immunity from dental decay are prolonged breast feeding with a supplementary diet often for three or even six years and a high intake of vitamin D (or exposure of the body to the sun) together with a sufficiency of calcium and phosphorus A high carbohydrate diet (cereals or potatoes) is compatible with good teeth provided the supply of vitamin D, calcium and phosphorus is also sufficiently great Caries is especially rampant where cereals form a large part of the diet, breast-feeding is short, the intake of milk, eggs and animal fats is small and sunshine is negligible or rendered ineffective by clothing.

It has thus been shown that perfectly calcified and regularly arranged teeth can be produced by including in the maternal diet during pregnancy and lactation, and in the diet of the offspring at the time of dental development, substances containing much vitamin D, calcium and phosphorus, such as milk, eggs, fish and animal fats, and that cereals, especially those rich in embryo such as oatmeal, tend to produce hypoplastic teeth and call for a correspondingly larger supply of calcifying foods for good development. It has further been established that the teeth of the majority of children in Great Britain are imperfect in structure; that dental caries is more likely to attack such teeth than perfect teeth with normal enamel and dentine and a smooth surface; that the resistance to caries can be increased independently of the original structure by giving a diet containing much vitamin D, calcium and phosphorus or decreased by a diet rich in cereals. If these general principles of feeding were widely adopted, there is little doubt that dental caries (and also pyorrhœa, to which a deficient intake of vitamin A predisposes) will cease to be the scourge they are at the present time. It may finally be pointed out that none of these conclusions conflicts with the generally accepted idea that the *exciting* cause of caries is the growth of micro-organisms in the mouth; the novelty is the proof that the tooth can resist the onslaught of the microbes by the absorption and assimilation into the body tissues of certain specific dietary factors.

Obituary

Mr. E. M. Eden

EDGAR MARK EDEN died on February 10 at the age of sixty years. He was the eldest son of William Eden, an artist, and was educated at University College, London. After a period with Messrs. Willans and Robinson, ended by ill health from which he was never wholly free, he became a demonstrator at University College under Prof. Hudson Beare, by whom he was greatly influenced. In 1907 he became lecturer at Armstrong College, where he remained until his life work began in 1915.

The National Physical Laboratory had undertaken the testing of all gauges for the manufacture of munitions. The old methods were inadequate to deal with the immense number of gauges, and especially screw gauges; entirely new and simpler methods were necessary. Here Eden's genius found its appropriate field. Many others shared in the work, but they would agree that every method finally adopted owed something to his inspiration, and that many of the most important owed everything. The simple machines that he devised for the most intricate measurements did much more than solve an urgent war problem. They enabled British manufacturers to test their own products and to raise appreciably their standard of accuracy. In the list of those who have led the post-War reconstruction of our industries Eden's name should stand high.

In 1919 Eden joined the original staff of the newly founded Research Laboratories of the General Electric Co., Ltd., as head of the workshops. His work now covered a much wider range, but knowledge of it was necessarily confined to a narrower circle. Discerning visitors to the Physical Society's Exhibition will have realised that its quality remained unchanged; but only his colleagues know how much of any success they may have achieved is due to it.

It is impossible to describe examples of his work in a few words; reference must be made to published accounts, for example, in Rolt's 'Gauges and Fine Measurements' and in the *Journal of Scientific Instruments* (May 1922, and vol. 2, p. 119). All his work had a common feature: an economy of means and of material characteristic alike of the best science and the best art. Among modern Englishmen only Rayleigh and Horace Darwin can be compared with him in this matter. Like them he always went straight to fundamentals; he would not even take a hackneyed formula from a textbook; he always worked it out for himself. The colleague who brought him a sketch was often disconcerted to find the final apparatus shorn of all his cherished ingenuities; but it always worked at a first trial, and achieved exactly what was required of it, neither more nor less.

The same hatred of elaboration and ostentation inspired Eden's private life. He loved wild flowers but not the formal garden; the elegance of Mozart but not the grandeur of heavy orchestration. It made him a true peace lover; only his duty to his young family persuaded him, after a bitter struggle, to take even an indirect part in hated strife. Yet he was no shrill pacifist; quarrels vanished like smoke before his genial smile and kindly, but caustic, humour. He was a perfect host; and his accounts of workshop doings at staff meetings were so entertaining that they became recognised as among the Laboratory treats. We are all much poorer for his loss, though the world at large may never know it. He leaves a widow and four sons.

Dr. H. M. Cadell

THE sudden death of Dr. H. M. Cadell on April 10 at the age of seventy-three years has deprived Edinburgh and its neighbourhood of a distinguished scientific worker and of one who played a conspicuous and most useful part in the life of the community. Born in 1860, he was educated at the University of Edinburgh and at

Clausthal Royal Mining Academy, Germany He was one of the first band of students who studied under Archibald Geikie, and at the age of twenty-three years he became a member of H M Geological Survey He always regarded it as a privilege that he was sent to the field as a junior member of the staff under Peach and Horne in the survey of the north-west Highlands, and an account of his laboratory experiments illustrating the mode of production of the complicated tectonics of that region is included in their classic memoir On succeeding to the family estate in 1888 he retired from the Survey after only five years' service, but his interest in geology and geography continued unabated, and he was the author of a long series of geological and geographical papers, many of which were the results of observations made during his frequent and extensive travels

Cadell's more important publications dealt with the oil shale field and general geology of West Lothian, and with the geological history of the Forth valley He was essentially a practical geologist and took an active part in the development of the coal- and oil shale fields of West Lothian, and in the reclamation of the muddy foreshore along parts of the Firth of Forth He was also interested in the exploitation of the coal resources of Spitsbergen

The various scientific societies in Edinburgh particularly the Royal Scottish Geographical Society, the Royal Society of Edinburgh, and the Edinburgh Geological Society owe Dr Cadell a great debt of gratitude for many services rendered and for generous financial support He led the life of a country gentleman and became a county magnate, serving in various capacities on the County Council of Linlithgow, and becoming Deputy Lieutenant He also served in the 'volunteers' for twenty-four years and retired in 1906 with the rank of Lieut Colonel and Hon Colonel, V D

Cadell's services to the University of Edinburgh were many, and special mention may be made of the interest he took in the founding of the chairs of mining and of geography As a recognition of his scientific attainments and public work he was awarded the honorary degree of LL D by the University in 1932

It is rare to find combined in one personality gifts of such a varied nature, and he will be greatly missed in Edinburgh T J JEHU

DR J P VAN DER STOK

JOHANNES PAULUS VAN DER STOK was born on January 14, 1851, at Zuilen, near Utrecht He studied at the University at Utrecht and took his degree of doctor in physics and mathematics in 1874 In 1877 he went to Java as sub-director of the Magnetic and Meteorological Observatory at Batavia, was appointed director in 1882 and retired as such in 1899

Van der Stok's first publications dealt with periods in terrestrial magnetism and meteorology in relation to the sun and moon, and the observatory at Batavia co operated in many international researches in seismology, terrestrial magnetism and cloud studies His most important work, however, were his tidal studies, based on Darwin's method By a skilful arrangement of direct readings of tide gauges at well chosen hours, and many original methods of discussing the results, he was able to disentangle completely the very complex tidal phenomena in the Archipelago The results have been published in a series of sixteen papers and in the atlas 'Wind, Weather, Tides and Tidal Streams in the East Indian Archipelago" Tide prediction, highly important for shipping especially near Sourabaya, has since been carried out by Van der Stok's methods largely by native assistants

After his return to Holland, Van der Stok became director of the oceanographical department of the Meteorological Institute at De Bilt and remained so until 1923 There his principal work was the supervision of the publication of oceanographical atlases of the Indian and Atlantic Oceans, but he continued also his tidal work and published an "Elementary Theory of the Tides" with numerous tidal constants for the East Indian Archipelago, which has been translated into German He also published through the Amsterdam Academy of Sciences many studies in climatology and dynamical meteorology He was the first to introduce stability' as a numerical indication of the degree of variability in direction of wind and current vectors, and one of the first to use and investigate frequency tables and curves in climatology—we need only mention his treatment of tides in the North Sea and of the climate of the North Sea deduced from lightship observations After several years of illness, borne with exceptional patience and cheerfulness, he died on March 29, 1934, at the age of eighty three years Throughout the world his name will be gratefully remembered

E VAN EVERDINGEN

THE death is announced of Frederick William Christian, anthropologist and explorer, city librarian of Christchurch, New Zealand, which took place at the age of sixty six years at Wellington, N Z F W Christian the son of E H Christian, was born at Putney Hill on June 15, 1867, and educated at Eton and Balliol College, Oxford After taking his degree he became interested in the exploration of the Pacific, and more particularly of the islands of Micronesia His ethnographical observations in this area were of enduring value and continue to be the best and most authoritative account of some of the lesser known islands His best-known and most frequently quoted work is "The Caroline Islands" (1899) He also published 'Eastern Pacific Lands" (1910) and a comparative study of a number of the Oceanic languages He was a frequent contributor to the publications of the Polynesian Society and other scientific journals

News and Views

Sir Sidney Harmer, K B E, F R S

SIR SIDNEY HARMER, who received the Linnean Medal at the anniversary meeting of the Linnean Society on May 24, has had a long and distinguished career as a zoologist, and is still actively engaged in research His published works deal for the most part with two widely different groups of animals, the Polyzoa and the Cetacea His first paper (1884) described the anatomy of *Loxosoma*, and his most recent, issued this year, was the third instalment of his great report on the Polyzoa of the *Siboga* expedition Perhaps his most outstanding contributions to science have been the demonstration of the chordate affinities of *Cephalodiscus* (published in an appendix to McIntosh s *Challenger* Report, 1887), and his discovery of embryonic fission in cyclostomatous Polyzoa (1893) While superintendent of the University Museum of Zoology, Cambridge, Harmer, in collaboration with the late Sir Arthur Shipley, planned and edited the great Cambridge Natural History the ten volumes of which appeared between 1896 and 1909

IN 1909 Harmer left Cambridge to become keeper of zoology in the British Museum (Natural History) and ten years later he was appointed director of that institution Shortly after he went to the Museum he devised a scheme with the co-operation of the Board of Trade and the Coast Guard, for recording the occurrence of Cetacea stranded on the British coasts, and in the course of twenty years a vast amount of information has accumulated in regard to the distribution, migration, and seasonal occurrence of the various species Much of this information, but not the whole of it has been embodied in the ten reports published by Harmer From the beginning of his association with the Museum, Harmer also took a leading part in pressing on successive governments the urgent need for the regulation of the whale fisheries, particularly in the Antarctic His efforts were largely responsible for the organisation of the very important scheme of oceanographical research now being carried out by Dr Stanley Kemp and his staff for the 'Discovery' Committee, an undertaking which can only be compared in importance with the *Challenger* expedition

Prof W B Scott

THE Boston Society of Natural History has awarded the Walker Grand Honorary Prize of 500 dollars to Prof. William Berryman Scott, of Princeton, New Jersey, for 'his half century of conspicuous effort to advance the science of vertebrate paleontology in North America" Prof Scott is professor emeritus at Princeton University, where he held the Blair professorship of geology and palæontology from 1884 until 1930 He was born in Cincinnati, 1858, received his bachelor's degree from Princeton, Ph D from Heidelberg, LL D from the University of Pennsylvania, and honorary doctorates of science from Harvard and Oxford He is a past president of the Geological Society of America and the Paleontological Society of America, his specialty having been vertebrate palæontology He is the author of a well known geological textbook, also of the 'History of Land Mammals in the Western Hemisphere", and of the Theory of Evolution", and has written some fifty monographs on geological and palæontological subjects The Walker Grand Prize is awarded by the Society from the trust fund given by Dr William J Walker in 1864 not oftener than once in five years, for such scientific investigation or discovery in natural history as the Society may think deserving thereof, providing such investigation or discovery shall first have been made known and published in the United States The award is made solely for merit

Henry Francis Blandford, F R S (1834–93)

HENRY FRANCIS BLANDFORD, the distinguished meteorologist and geologist, brother of William Thomas Blandford (1832 1905) president of the Geological Society, was born in Bouverie Street Whitefriars London on June 3, 1834 Like his brother, he was trained at the Royal School of Mines under De la Beche Smyth and Percy and at the Mining Academy of Freiburg, and in 1855 with his brother joined the Geological Survey of India After serving for seven years ill health compelled him to resign from the Survey and he became a professor at Presidency College, Calcutta, a post he held from 1862 until 1874 From 1867 he was also meteorological reporter to the Government of Bengal, making a close study of cyclones, and in 1874 was appointed chief of the Meteorological Department of India Retiring in 1888 he took up his residence at Folkestone He died on January 23, 1893, at the comparatively early age of fifty eight years Elected F G S in 1862, and F R S in 1880, in 1884 he was elected president of the Asiatic Society of Bengal He wrote some fifty papers on meteorology and geology, and his work as a meteorologist caused him to be elected an honorary member of various foreign meteorological societies

Francesco Denza, 1834 94

ON June 7 the centenary occurs of the birth at Naples of Father Francesco Denza, the eminent Italian astronomer and meteorologist At the age of sixteen years, he joined the order of Barnabites and studied at Rome, where he came under the influence of Secchi, the astronomer From 1856 until 1890 he was attached to the Barnabite College at Moncalieri, where in 1859 he established an observatory Keenly interested in meteorology, he did much to further its study in Italy, founding the *Bollettino mensile di Meteorologia*, and in 1881 was chosen to be the first president of the Italian Meteorological Society He was also well known for his observations on meteors and his researches in terrestrial magnetism He represented the Pope at the Congress of Scientific Societies held in France in 1884, and again at the Paris Congress held in 1887 to inaugurate the Astrographic Chart of the heavens. Through him the Vatican Observatory was chosen as one of the eighteen observatories to take photographs for the preparation of the Chart, and in 1890 he was appointed as its director. He died at the Vatican on December 14, 1894, at the age of sixty years. He had been elected an honorary member of the Royal Meteorological Society in 1870, and at the time of his death was president of the Accademia dei Nuova Lincei.

Prof. Ernst Küster

PROF. ERNST KÜSTER, who has been for thirty-one years editor of the *Zeitschrift für Wissenschaftliche Mikroskopie*, has been elected to honorary fellowship of the Royal Microscopical Society. Prof. Kuster is professor of botany in the University, and director of the Botanical Institute and Gardens, Giessen. He was previously assistant in the Botanical Institutes at Munich and at Halle, professor of botany in the University of Kiel, and later in the University of Bonn. He is the author of "Pathologische Pflanzenanatomie" (3rd Ed., Jena, 1925), "Anleitung zur Kultur der Mikroorganismen" (3rd Ed., Leipzig, 1921), "Ueber Zonenbildung in kolloidalen Medien" (2nd Ed., Jena, 1931), and other botanical treatises, and of numerous scientific papers.

Economics of Nutrition

In the report of the Committee on Nutrition of the British Medical Association published last winter, the daily requirement of food was assessed at 3,400 Calories, and it was recommended that it should contain 50 gm. of animal or first class protein. These figures differed from those of the Committee of the Ministry of Health, which were 3,000 Calories and 37 gm. of animal protein. A controversy arose as to which set of data was correct. A conference of representatives of the two committees has since met and published a joint report (London: H.M. Stationery Office. 2*d*. net). The Ministry's Committee gave 3,000 Calories as a guide for the energy value for large communities and institutions. The figure of 3,400 Calories of the British Medical Association Committee was meant to apply to families with children with the man performing a moderate amount of muscular work, and to be subject to an allowance of 10 per cent for waste. As was stated in an article discussing the position in NATURE of January 13, p. 53, there is no real difference between the figures. The joint committee points out that no hard and fast line can be taken for differences in age and differences in work, and it gives a scale of Calories for different people. It is agreed that 80–100 gm. of total protein suffices for the daily need, the precise amount depending upon physique, occupation, habits, taste and climate. As regards the amount of animal protein, it is pointed out that there has never been any exact determination of the desirable proportion of animal to vegetable protein, and that 37 gm. is the lowest value obtained from statistics; 50 gm. is recognised as a good value for families with growing children, who need relatively more animal protein than adults.

Helium and Other Rare Gases

IN the second Research and Development Lecture delivered under the auspices of the British Science Guild at the Royal Institution on May 30, Lord Rutherford said that there is no more interesting story in the history of science than the sequence of events, towards the close of the last century, which led to the discovery and isolation of a new group of rare gases existing in the atmosphere by Lord Rayleigh and Sir William Ramsay. The discovery that argon is present in the air in about one per cent by volume was rapidly followed by the discovery of a whole new group of inert gases, namely helium, neon, krypton and xenon. Neon is present in the air in only about one part in 100,000 by volume, and helium, krypton and xenon are present in still smaller quantities. In the early stages, these gases could only be separated in small quantities after much expense and trouble, and in a sense were regarded as scientific curiosities. The subsequent development of large liquid air plants for the separation of pure oxygen from the atmosphere, in which many thousands of tons of air are liquefied annually, made possible arrangements for the separation of argon and neon in considerable quantities. On account of their characteristic properties some of these gases have been found exceedingly useful to industry. For example, more than 30,000 cubic metres of argon are used annually in Europe in the production of the highly efficient gas filled electric lamps. In all, about 45 million of these lamps are made each year, requiring the separation of argon from more than 5,000 tons of air. The ease with which an electric discharge passes through neon, and its characteristic luminosity, have led to a great development in the use of this rare gas for the illuminated signs with which we are so familiar in our cities to-day.

IN some respects, however, the history of the use of helium is still more striking. The presence of this gas was first detected in the sun by Sir Norman Lockyer in 1868 and for this reason he named it 'helium'. The presence of helium on the earth was first observed by Ramsay in 1895 in the gases released from old radioactive minerals. In the course of the next ten years, a few cubic metres of helium were laboriously extracted from radioactive minerals. During the War, the Board of Invention and Research of the Admiralty recognised that it would be much safer if observation balloons and dirigibles could be filled with a light, non-inflammable gas like helium rather than with hydrogen, for there is only eight per cent difference in their respective lifting powers. At the suggestion of the Board, Prof. J. C. McLennan, of the University of Toronto, made a systematic examination of the helium resources of the Empire. It was found that large supplies of helium were available in the natural gas fields of southern Alberta, and arrangements were made on a semi commercial scale to purify the helium by liquefying the methane and other gases present About the same time, the Bureau of Mines of the United States began similar experiments, using the natural gases of Texas, which are rich in helium At the end of the War, millions of cubic feet of helium were separated by liquefaction methods, and the cost was found to be sufficiently low to use it in airships in place of hydrogen The U S airships, the *Shenandoah* and the *Akron*, were both filled with helium to avoid the dangers of fire Apart from this and other industrial uses, helium is of great importance in the liquid form for attaining temperatures not far removed from absolute zero A number of cryogenic laboratories employing liquid helium are in active operation in Europe, Canada and the United States, for the study of the properties of matter near the absolute zero of temperatures

Congress of Anthropological and Ethnological Sciences

A PRELIMINARY programme of the first session of the International Congress of Anthropological and Ethnological Sciences to meet in London under the presidency of the Earl of Onslow from July 30 until August 4 next is now available The headquarters will be at University College, Gower Street, W C 2 The inaugural meeting will take place in the Great Hall of the College on July 30 at 3 p m , when H R H the Duke of York will receive the delegates and declare the Congress open, and Lord Onslow will deliver his presidential address On the same day at 10 p m H M Government will hold a reception of the members of the Congress at Lancaster House, St James's, S W The business of the Congress will be conducted in general and sectional meetings At the first of the general meetings, which will be held on July 31 at 8 30 p m , Sir Aurel Stein will deliver the Huxley Memorial Lecture of the Royal Anthropological Institute and will receive the Institute's Huxley Memorial Medal for 1934 At subsequent general meetings in the evenings of the following days the Congress will be addressed by Dr R R Marett, Prof T C Hodson, and Prof J B S Haldane, each of whom will deal with some one aspect of present tendencies in anthropological studies Communications addressed to the Congress by its members will be submitted to meetings of the sections, of which there will be eight, each one dealing with a major division of the studies with which the Congress is concerned

So far as it is possible to judge from this preliminary outline, the proceedings of the sections will be of the greatest interest In each section topics of inquiry are suggested, although members are not thereby necessarily precluded from submitting communications on other matters In the Anatomical and Physical Section, which will meet under Prof Elliot Smith, for example, the central theme will be man's place among the primates In most sections, however, the range is sufficiently wide to cover all points which members are likely to have time or desire to discuss Joint meetings between two or more sections occupy a prominent place in the programme The Section of Ethnography, which, naturally, is expected to have the heaviest list of communications, will meet in three divisions, General Ethnography under Dr A C Haddon, African Ethnography under the Rev E W Smith and American Ethnography under Capt T A Joyce The last named sub section has been specially arranged with the view of welcoming American workers on their way to attend the International Congress of Americanists to be held later at Seville It will take as its central theme of discussion the interrelation of pre Spanish American culture centres and their possible connexion with extra American influences, affording it is hoped, a welcome opportunity for placing on record the results of the most recent developments in research In the African Section current problems impinging on questions of administration and the future development of the African will be kept well in view The subscription to the Congress is members £1, associates 10s Further particulars may be obtained from the Congress Secretaries c/o the Royal Anthropological Institute, 52 Upper Bedford Place, London, W C 2

Japanese Trade Competition

JAPANESE competition in the world s markets is more than a new and noteworthy fact Discussing the matter in a recent issue of the *Industrial Chemist*, Sir Harry McGowan chairman and managing director of Imperial Chemical Industries, Ltd , shows that by no means the whole story involves the long hours of work and the low standard of living of the Japanese worker , contributory aids to Japan s advance are her realisation that in times of depression, price is more important than quality, and her study of the needs of individual markets Her manufacturers give each customer what he wants at the time and place that it is wanted, and patterned, designed, and packed in a manner to please his particular fancy They quote in his own language and express units of quantity and price in the measurements of his country ' Japan needs to sell goods abroad to maintain some equilibrium in her trade balance, to support her rapidly growing population, and to pay for her increasing armaments She has the advantage of a considerably depreciated currency , a newcomer into the industrial arena, she has bought the most up to-date machinery and adopted the most suitable methods, and she has organised her industries in large scale units She has evolved a system of industrial and governmental co-operation in the conduct of export campaigns Sir Harry McGowan counsels us to take prompt and vigorous steps to put ourselves so far as possible on a competitive basis We will not, and indeed cannot, depress the standard of living of our work people, but we can reap the advantages of industrial organisation and the effective planning of export trade The time has come for closer personal contact between British and Japanese industrialists, and for discussion which will lead to a tempering of healthy competition with reasonable co-operation

Reclamation of the Pontine Marshes

IN the *Engineer* of May 11 and 18 is an illustrated account of the work being done in connexion with the reclamation of the famous Pontine Marshes in southern Italy This work has been rendered possible by the passing by the Italian Government of the law of the Bonifica Integrale', commonly known as the Mussolini Law, 1928, which authorised the expenditure of 7,000 million lire (£113,000,000) for works of public utility such as irrigation and water supply schemes, roads, and reclamation projects 'Among these great works of agricultural reconstruction," says the *Engineer*, "the reclamation of the Pontine Marshes deserves particular attention, not only on account of their geographical position almost at the doors of Rome (40 miles distant), and of their history, but above all from a technical point of view, as it is the first time in history that a similar vast enterprise has successfully been carried out, and that a flourishing town—Littoria—has, magic like, risen within thirteen months from its inception on what were the pestilential malaria stricken and deadly Pontine Marshes" The area of the marshes, across which once ran the Via Appia, is some 60,000 acres, and its reclamation had been discussed from the days of Caesar to Napoleon But it remained a blot on the prestige of Italy In 1926, however, a scientific survey of the district, its rainfall and geology, was carried out and each succeeding year has seen the construction of canals for drainage or irrigation, the erection of pumping and power stations, the clearing of woods, the breaking up of the soil and the settlement of some thousands of people on the recovered land The colonisation of the area is being carried out by the Opera Nazionale Combettenti (National Ex Service Men's Organisation) which provides each family of colonists with a house, live stock and fodder, implements, seeds, etc, guarantees to pay for produce at market price and arranges easy terms of purchase By October 1935 it is considered the scheme will see the colonisation of about 5,000 families, representing a population of 50,000

River Water Survey

THE forty first annual report of the West Riding of Yorkshire Rivers Board for the year ended March 31 covers an extensive area, embracing, in part or in whole, the basins of the Lune, Ribble, Ure, Nidd, Wharfe, Aire, Calder, Don and Trent, therefore it naturally comprises a number of scientifically interesting, though miscellaneous, items of information, which cannot be effectively summarised within brief compass As the twelve months in question coincided with the prevalence of the abnormally dry season which has made a shortage of water unpleasantly felt throughout Great Britain, it is not surprising to learn that "for extraordinarily lengthy periods the flow of the main rivers passing through the thickly populated manufacturing areas dwindled to about half the normal volume and a very large proportion of the water consisted of compensation water and effluents from sewage works and trade premises" The Aire and the Calder, it is stated, continue to be the worst polluted streams in the West Riding, but the sources of pollution have become more and more localised as the work of the Board has proceeded. On the subject of excessive river pollution following sudden heavy downpours after long spells of dry weather, the explanation is put forward that during dry weather the whole flow of sewage can be fully treated at sewage works, and during continuously wet weather the dilution afforded by the streams is sufficient to obliterate the effects of the discharge of storm water sewage and surface water drainage, but that a heavy shower in dry weather may carry intense pollution into a depleted river An analysis is given of a sample of river water from the Calder at time of maximum flow after heavy rainfall, demonstrating in a striking way the intensive wave of pollution set up under such conditions

REFERENCE is made in the report to the important matter of river gauging, and it is stated that consistent attempts have been made to persuade local authorities to take a greater interest in the work and to co operate in extending activities over a greater number of streams It is satisfactory to find that these efforts have been attended by some degree of success, though the report adds "it has required the rather alarming experiences of the droughts of 1929 and 1933 to make it evident that a comprehensive scheme of stream gauging is one of the essentials in regard to a systematic survey of the country's water resources" The action of the British Association in appointing a committee to investigate the question of an inland water survey is sympathetically alluded to, and it is stated that the Board has been asked by the Institution of Civil Engineers to co operate in the movement by allowing its records of river gaugings to be made available for inclusion in a comprehensive survey which the Institution has in contemplation (see NATURE of Nov 11, 1933, p 725, and April 28, 1934, p 625)

Food Supply and Public Health

IN his Chadwick Public Lecture delivered on May 29, Dr John Boyd Orr discussed the national food supply and public health He stated that, if necessary, Great Britain, which at present imports about half of its foodstuffs, could increase production sufficiently to become self supporting Between 1913 and 1928, the world's food production increased by 16 per cent, whereas the population of the world increased by only 10 per cent But the amount of food a person can eat is limited, and in the case of some products, notably wheat, production has outrun consumption In 1932, the world's requirement in the international wheat market was 525 million bushels, whereas the exportable surplus of the great wheat producing countries was 1,105 million bushels. The problem with regard to the supply of certain foodstuffs is now, not how to secure a sufficient supply, but rather how to dispose of the surplus, which is encumbering the world economic system Governments are attempting, through international conferences, to evolve schemes to limit production.

This super abundance of certain stable foodstuffs has led to a cheap food supply for the people—at least for certain kinds of food Unfortunately, those foodstuffs which have a special health value are still relatively expensive At present retail prices, 3,000 Calories, roughly the amount required by an average man, can be obtained in the form of certain foodstuffs, for example, white bread, rice, sugar, margarine, for *3d*–*5d* , but the same number of Calories costs about *2s* in the form of milk, *3s*–*5s* in the form of vegetables, *4s* in the form of eggs, and *1s*–*3s* in the form of meat Production of these more expensive foodstuffs is increasing in efficiency with a corresponding fall in wholesale prices Distribution, however, is still relatively inefficient and expensive and schemes for the marketing of agricultural produce are now being undertaken

Suppression of Weeds

OUR knowledge in the use of artificial fertilisers has now become very extensive, and a great deal of information has also been acquired with regard to the destruction of weeds by chemical means Further, certain fertilisers have a two fold value in that they act as weed destroyers as well as encouraging the growth of the crop Spraying for weed eradication was introduced in France towards the end of last century, when copper sulphate was used to kill charlock and wild radish The practice soon became widespread and at the present time the use of sulphuric acid is rapidly becoming a recognised means of destroying various annual weeds in cereal crops, as is also the fertiliser cyanamide, while chlorates seem likely to attain a position of importance in the future for the destruction of particular weeds in certain circumstances Mr H C Long of the Ministry of Agriculture has just published a simple and concise account of the subject in a brochure entitled The Suppression of Weeds by Fertilizers and Chemicals ' The use of lime calcium cyanamide, sulphuric acid, sulphates of copper and iron, chlorates and arsenical compounds are the substances chiefly dealt with, and recommendations for the destruction of many weeds that commonly occur in serious quantities are described The booklet extends to 57 pages, and includes 17 photographic illustrations and 5 line drawings It may be obtained from the author at 'The Birkins", Orchard Road, Hook Surbiton, price *2s* net (by post *2s 2d*)

Sociological Studies

Two reports in the Special Report Series ' of the Medical Research Council, recently issued (London H M Stationery Office), are of considerable, though somewhat specialised, interest No 190, A Study of Growth and Development", by Miss R M Fleming contains a record of observations in successive years on the same children, with continuous observation on a number of anatomical characters, and an attempt to relate to them psychological characters of the growing individuals and their reactions to the physical and psychical environments in which they lived No 192, "Housing Conditions and Respiratory Disease", by Dr. C M Smith, deals with the amount, nature and incidence of sickness occurring during one year among a population of two thousand people living in a poor quarter of Glasgow, one half being housed in a slum type district, the other half in a rehousing scheme area Comparison of the morbidity in the two groups does not yield conclusive results, and the value of the work lies rather in indicating the fallacies and difficulties involved in reaching reliable conclusions in investigations of this kind

Blindness

SIR JAMES BARRETT has prepared an analysis of the causes of their blindness in applicants for admission to an Institute for the Blind (*Med J Australia*, 1933, December 30, p 872) Among those over fifteen years of age, myopia (short sightedness) heads the list with 15 per cent of the total Of all cases, venereal diseases probably cause 40–50 per cent In another paper in the same journal (July 15 p 69), Sir James gives an account of the development of the Braille system Introduced in 1834, various modifications were attempted, so that at the end of last century there were several kinds of Braille in the English speaking world In 1905, Great Britain decided to adopt Braille uniformly , about the same time the Americans appointed examiners to inquire into the various Braille systems, and in 1913 they reported that the original Braille system came out of the test as the best, and it was adopted in America in 1918

Crocodiles and Alligators

A NEW part of Das Tierreich by Dr Franz Werner of Vienna (Pp xiv+40 Berlin and Leipzig Walter de Gruyter and Co 8 75 gold marks) deals with Reptilia Loricata and contains keys and short descriptions of the distinguishing characters of gavials, crocodiles and alligators, as well as short notes on colour, habitat and distribution The characters selected as discriminating are readily appreciated and the descriptions are helped by 33 text figures Old names are changing , the once familiar *Crocodilus niloticus* has become *Champse vulgaris*, and as a generic name *Crocodylus* is, paradoxically, confined to two alligators from South America, one of which is named *Crocodylus niloticus* —a native of British Guiana, Bolivia and that region ! This and other points are referred to in a letter on p 835 of this issue

Investigations of Rudi Schneider

IN the article 'From a Correspondent" on MM Osty s investigations on Rudi Schneider in our issue of May 19, p 747, the importance of an independent repetition of these experiments is urged Prof D F Fraser Harris writes to direct attention to the investigations of Lord Charles Hope and others published in the *Proceedings of the Society for Psychical Research* of June 1933 These experiments, however, did not include any graphs of the rhythmic obscuration of an infra red ray in time with Schneider's breathing, to which our correspondent specially referred

Tenth Satellite of Jupiter

ACCORDING to *Science Service*, Dr H M Jeffers of the Lick Observatory photographed a very faint object (of the nineteenth magnitude) which appears to have the same motion in the sky as the eighth satellite of Jupiter The new satellite has presumably a diameter even smaller than that of the eighth, which is only 25 miles If the new object's identity as a satellite of Jupiter is established that planet will lead the field as a satellite holder, Saturn having but nine Jupiter is now very prominent in the evening sky, and the four brightest satellites can be seen with a modest telescope But for the glare from the planet they should just be visible to the naked eye in a good climate (It has been stated that certain Kalahari natives *can* distinguish Jupiter s satellites with the naked eye) With the most powerful telescope, however, nobody will *see* the new satellite of the nineteenth magnitude It can only be photographed by giving fairly long exposures on a large telescope

Announcements

MAURICE, DUC DE BROGLIE has been elected to a seat in the Académie Française the section of the Institut de France which concerns itself with language and literature M de Broglie is well known as a physicist for his work on X ray spectra and allied subjects, for which he was awarded the Hughes Medal of the Royal Society in 1928 For the past ten years he has been *académicien libre* of the Académie des Sciences, which is the scientific section of the Institut de France

THE second conversazione this year of the Royal Society will be held at the Society s rooms on June 20 at 9 p m

IT is announced in the *Times* that Sir Charles Brooke, Rajah of Sarawak, has given £20 000 towards the building scheme for the Imperial Forestry Institute at Oxford

THE research laboratories of the Callenders Cable and Construction Co , Ltd , 38, Wood Lane, Shepherd's Bush, London, W 12, will be opened by Lord Rutherford on Friday, June 22

THE annual general meeting of the British Science Guild will be held in the lecture theatre of the Royal Society of Arts on Tuesday, June 12, at 4 p m Following the meeting, a popular lecture entitled Friction" will be delivered by Prof E N da C Andrade

AT the anniversary meeting of the Linnean Society of London held on Thursday, May 24, the following officers were elected —*President* Dr W T Calman, *Treasurer* Mr F Druce, *Botanical Secretary* Mr John Ramsbottom, *Zoological Secretary* Dr Stanley W Kemp The Linnean Gold Medal was presented to Sir Sidney Harmer

THE secretary of the University Press of Liverpool, referring to the notes on the centenary of the Liverpool Medical School in NATURE of May 19, p 753, asks us to state that The Liverpool Medical School 1834–1934" is the production of the University Press, and is published by the Press, with Messrs Hodder and Stoughton, Ltd

UNDER the title of 'The Silk Industry of Japan" the Imperial Council of Agricultural Research (India) has issued (1933) a comprehensive monograph by Mr C C Ghosh on this subject It is primarily based upon the results of a study made by Mr Ghosh in Japan in 1929 and provides a useful illustrated account of the biological, technical and administrative aspects of the industry The work can be obtained through booksellers, or through the Office of the High Commissioner for India, Aldwych, London W C 2, price 6*s* 9*d*

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A lecturer in physics and elementary science (including nature study) at the City of Leeds Training College—The Director of Education, Education Department, Calverley Street, Leeds (June 5) A teacher of physical chemistry at the Northern Polytechnic Holloway London, N 7—The Clerk (June 6) An assistant professor and a lecturer in mathematics at the Royal Naval College, Greenwich —The Adviser on Education Admiralty, Whitehall, S W 1 (June 11) A lecturer in mathematics at the Constantine Technical College—The Director of Education, Education Offices, Middlesbrough (June 9) A temporary assistant lecturer in agricultural botany at the University College of North Wales, Aberystwyth—Prof R G Stapledon Agricultural Buildings, Alexandra Road, Aberystwyth (June 12). A lecturer in chemistry at the Medway Technical College, Gardiner Street, Gillingham, Kent—The District Education Officer, 15 Mew Road Avenue, Chatham (June 16) A part time assistant (biology) in the Department of History and Method of Science at University College, Gower Street, London, W C 1—The Secretary (June 16) A lecturer in political science at the London School of Economics and Political Science, Houghton Street, Aldwych, W C 2 —The Secretary (June 22) Examiners in various branches of science in the University of London—The External Registrar, University of London, South Kensington, S W 7 (July 8) A professor of mining and a professor of geology in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner, South Africa House, Trafalgar Square, London, W C 2 (July 14) A senior lecturer in psychology, a lecturer in geology and a lecturer in mathematics (at Pietermaritzburg) and a lecturer in civil engineering, a lecturer in mathematics and chemistry and a lecturer in English and psychology (at Durban) in Natal University College—The Registrar, Natal University College, Pietermaritzburg (Aug 1) A technical adviser on industries to the Bureau of Industry and Commerce, Ceylon—The Crown Agents for the Colonies, 4, Millbank, London, S W 1

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Arbitrary Character of World-Geometry

PROF E A MILNE, in the important paper[1] in which he gives an account of an invariant distribution of particles forming an expanding universe in flat space time, has stated that the geometry adopted in cosmological theories may be chosen arbitrarily, the expression of the laws of Nature being relative to the geometry assumed A similar view has also been expressed by myself[2] The first enunciation of the idea, however, seems to have been due to Poincaré in quite the early days of relativity It is interesting in this connexion to observe that there is a very simple method of converting the law of motion of a particle expressed in the geometry of Einstein's theory to the corresponding law expressed in any other geometry

In general relativity the world line of any particle is a geodesic, a four dimensional track satisfying the principle

$$\delta \int ds = 0, \qquad (1)$$

where

$$ds^2 = \sum_{\mu\ \nu} g_{\mu\nu}\, dx_\mu\, dx_\nu$$

The g's are here functions of x_1 x_4 which when given fix the geometry of the manifold, the x s being arbitrary Gaussian co-ordinates, may be assumed to be the space and time measures of some (usually specially defined) observer Multiplying by a dimensional constant and, top and bottom, by the element $d\sigma$ of any parameter we can write the geodesic principle as

$$\delta \int m \sqrt{\sum g_{\mu\nu} \frac{dx_\mu}{d\sigma}\frac{dx_\nu}{d\sigma}}\; d\sigma = 0 \qquad (2)$$

But in this form the equation can be interpreted in *any* geometry Thus if $d\sigma$ is the interval of any specified fourfold, (2) becomes a principle of stationary action in that fourfold,

$$\delta \int W d\sigma = 0, \qquad (3)$$

where W, the weighting function of $d\sigma$, is, with given g s, a known function of the co ordinates and direction cosines of the (now curved) track at each point Or if in (2) we write for σ the t of flat space time, we have Hamilton's principle direct,

$$\delta \int L dt = 0,$$

with the Lagrangian L a known function of co ordinates and components of velocity From this the motion in ordinary space of the particle is obtainable in the usual way

The philosophic implications of such a conversion are considerable The motion of a particle being described generally as a track of stationary action (of a ray of light, zero action), in

$$\delta \int dA = \delta \int \frac{dA}{d\sigma}\, d\sigma = 0$$

the invariant element of action dA may be factorised in arbitrary ways into action gradient $dA/d\sigma$ and interval $d\sigma$ The latter fixes the geometry and the former is the weighting function W in (3) The physicist working on classical lines naturally adopts the simplest geometry, flat space time, throwing the burden of accounting for non uniform motion on the weighting function, which describes in effect a 'field of force' The relativist, going to the other extreme, throws the whole burden on the geometry But though these extreme ways are the simplest the burden clearly can be distributed arbitrarily between W and $d\sigma$, these being adjustable co factors of the more fundamental thing, action Action itself, comprising them both, transcends the ideas of geometry

In a paper published some years ago[3], I have shown that the electromagnetic laws also can be expressed by a principle of stationary action,

$$\delta \int dA = \delta \int \frac{dA}{dV}\, dV = 0,$$

where dV is a four dimensional volume element in the field The electromagnetic field, therefore, like the gravitational, is obtained by a factorisation of action, but now made differently, the co factors being action *density* and *volume* element The former of these effectively specifies the field, for in flat space time

$$\frac{dA}{dV} \equiv \tfrac{1}{2}\{(e^2 - h^2)^2 + 4(eh)^2\}^{\frac{1}{2}}$$

Since dV, like $d\sigma$, can be used to define a type of geometry, the feature of arbitrariness in the geometry assumed applies to both classes of field

S R MILNER

The University,
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April 23

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[1] *Z Astrophys* 6 Heft 1-2, 1933
[2] *Proc Roy Soc* A 139, 349 1933
[3] *Proc Roy Soc* A 120 483 1928

Maximum Optical Paths

ERRORS that have once appeared in print have a way of turning up in the most unexpected places As Dr Karl Darrow's interesting article on quantum mechanics in *Review of Modern Physics*, 6, 23 January 1934, is sure to be very widely read in Great Britain, it is not inopportune to refer to an old mistake that he repeats He states that optical paths are routes sometimes of minimum and some times of maximum time, and that for this reason it is appropriate to refer to them simply as stationary paths His foundation is wrong though his conclusion is right The facts are that the time happens to be a minimum when the path does not include an image of an end point of the range considered, but that if the path includes such an image, the time is neither a maximum nor a minimum—it is simply stationary Thus in Fig 1, if A', the image of A, is an internal point of the path interval APB, so that the optical

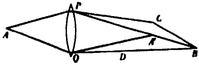

FIG 1

lengths APA' and AQA' are equal, the path $APCB$ is obviously longer and the path $AQDB$ obviously shorter than the stationary path $APA\ B$ It is clearly a trivial matter to demonstrate that no given optical path is ever a maximum

The error perhaps arose from a mistaken attempt to illustrate the alternate occurrence of maxima and minima by the various optical paths between the two foci of an elliptical mirror, and its currency is doubtless due to the fact that the coincidence in space of the object and image fields for reflection makes confusion of thought particularly easy It

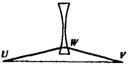

Fig 2

must be emphasised that the direct path, and paths including reflection at the mirror relate to different sets of conditions, and they should no more be confused than the direct path from U to V represented in Fig 2 should be confused with the refracted path UWV In refraction the distinction between the object and the image spaces is usually forced on a student's attention by the experimental conditions In reflection the importance of maintaining a similar distinction in his mind has to be forced on a pupil's mind by his instructor

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April 19

Plasticity of Bismuth due to Occluded Gas

BISMUTH crystals in the form of wires are described by Georgieff and Schmid[1] as being ductile if the (111) plane makes an angle $\varphi < 55° 42$ with the axis of the wire If $\varphi > 55° 42$, their crystals are brittle The ductility is due to slip along the (111) plane which is also the breaking plane of their crystals Gough and Cox[2], however, do not find any ductility due to slip of bismuth crystals of any orientation The only type of deformation of their crystals consists of twinning on planes of type (110)

The various attempts to explain this discrepancy[2] do not seem to take account of the fact that different methods are employed by the different authors to make the bismuth crystals concerned Georgieff and Schmid apply the Czochralski method, in which the liquid metal is raised, by means of a glass capillary out of a hole in a lid which covers the heated crucible and floats on the molten metal The rising metal is cooled by means of a stream of gas as it comes out of the lid Crystals of the diameter of the hole and of any length, can thus be obtained Gough and Cox apply the Bridgman method in which a cylindrical mould with tapering ends, filled with molten metal and carefully evacuated, is lowered slowly through a vertical tubular furnace Both methods have the common feature that a temperature gradient in a certain direction is achieved which makes the crystal grow in this direction

To check these results, both methods of making metal crystals were applied The bismuth used was Bi, purified" supplied by Hopkin and Williams, Ltd, London The cooling gas was nitrogen from a steel cylinder Some of the crystals obtained by the Czochralski method were brittle and some were ductile, and the latter showed after extension clear slip lines parallel to the (111) plane The brittle crystals showed twin formation when a tensile test was applied, giving audible 'cries', but no appreciable elongation So far, the results are in agreement with those of Georgieff and Schmid

None of the crystals obtained by the Bridgman method showed slipping in tensional tests, even when the (111) plane was suitably orientated for slipping They always broke along one of the other planes of (111) type, at normal stresses ranging from 337 to 712 gm/mm^2 (Accurate figures cannot yet be given owing to the lack of a suitable tensile machine) Profuse twinning sometimes occurred before breaking, accompanied by audible sounds (In compression tests however, even the crystals made by the Bridgman method exhibit slip Cylindrical rods become noticeably thicker in the direction perpendicular to the (111) plane and show clear slip lines There is no discrepancy here with the results of Gough and Cox as they use cycles of stress and therefore cannot apply forces bigger than the breaking force)

The explanation I suggest is that the crystals made by the Czochralski method contain a certain amount of the gas which is used for cooling The gas is responsible for the slipping of bismuth in tensional tests

To check this Czochralski crystals were heated *in vacuo* to about 600° C One could observe a large amount of gas coming out of the metal just after the melting point was passed The amount was estimated by measuring the pressure in a part of the diffusion pump set which could be separated from the pump and the volume of which was known Moisture was frozen out by means of a liquid air trap It was thus found that the single crystal contained about 3×10^{-4} molecules of nitrogen per atom of bismuth

Although every precaution was taken—for example the crystals were not touched by hands at all—this figure should be regarded with some reserve until further experiments check it fully But it seems to be certain that the content of gas is responsible for the slipping of a suitably orientated bismuth crystal in tensional tests

W F BERG

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April 16

[1] M Georgieff and E Schmid *Z Phys* 36 759 1926
[2] H J Gough and H L Cox *J Met Inst* 48 227 1932

A Magnetic Effect on Pirani Gauges using Nickel Wires

A PAIR of sensitive Pirani gauges, set up in this laboratory for another purpose, was found to be remarkably sensitive to small magnetic fields It seemed worth while to give a report of the phenomenon which may be of interest to those working in the field of thermomagnetic effects The gauges consist each of a thin nickel strip, 12 cm long and 0 003 mm by 0 05 mm in cross section They are mounted parallel and about 2 cm apart in a high vacuum, and are connected in two of the arms of a Wheatstone bridge, the other two arms being fixed resistances

A relay magnet about 6 cm away from the gauges (in the plane containing both wires) was found to produce a large deflection of the bridge galvanometer when energised The amount of the deflection depends strongly on the voltage across the bridge (that is, on the temperature of the nickel strips) The nature of the variation is shown in Fig 1 The abscissæ give the bridge voltages, with a rough scale of corresponding temperature, the ordinates give a quantity from which the bridge constants have been eliminated, and which represents the proportional change of resistance of one wire necessary to produce the observed deflection Since the effects in the two gauges are opposed, the actual change must be greater If the effect is thought of as a change in potential along the wires, the same quantity gives the proportional change of potential In the curve marked *A*, the line joining the poles of the magnet was placed perpendicular to the wires, in *B* parallel The peak in the curves occurs at or near the magnetic transition of nickel

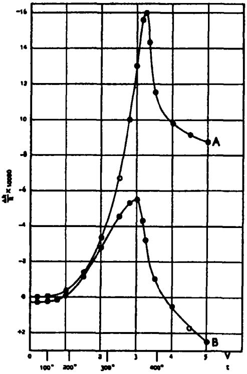

FIG 1 Magnetic effect on Pirani gauges plotted as equivalent relative resistance change against voltage across gauges and wire temperature Curve *A* magnet perpendicular to wire curve *B* parallel Note that curve *B* changes sign twice The peak in *B* may easily be caused by the superposition of some of the transverse effect

The effect is complicated by the presence of the residual field from a large electromagnet near the gauges This means that the field of the relay magnet must be considered as only a small change in an already existing field The geometrical relations are also too complicated for these results to be more than a rough picture of the phenomenon

The behaviour of the deflection on reversing the magnet current, reversing the bridge current, or putting the magnet near the other of the pair of wires, was just as would be expected if the effect were a simple change of resistance But the magnitude and the variation with temperature are widely different from the results of Knott[1] on nickel It is more likely that the effect is connected with the existence of a temperature gradient between the centre and the ends of the wires, being perhaps a change of the Thomson coefficient produced by the magnetic field Such a change is known to exist, but has apparently not been studied as a function of temperature

EDWIN McMILLAN.

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[1] L E Knott *Trans Roy Soc Edinburgh*, 41, 39, 1903. *ibid*, 45, 547 1907

Gaugain-Helmholtz (?) Coils for Uniform Magnetic Fields

THE use of two equal and co axial circular coils of wire, separated by a distance equal to their common radius and traversed by the same electric current in the same sense, has long been the standard practice for producing a nearly uniform magnetic field throughout an appreciable volume The question which seems unsettled is whether Helmholtz improved upon a device invented by Gaugain or invented the whole device by himself at an earlier date

In favour of the latter point of view is the statement by Wiedemann in 1883 (in a footnote to p 250 of the third volume of his 'Lehrbuch der Elektrizität") "Helmholtz hat das Princip dieser Bussole schon in der Sitzung der physikalischen Gesellschaft zu Berlin am 16 März 1849 mitgetheilt und zu derselben Zeit einen Apparat nach diesem Principe construirt und benutzt" I have not been able to find any other report of this session except the title of the lecture 'Princip bei der Construction der Tangentenbussolen' This, with the date, is given in *Fortschritte der Physik im Jahre 1849* (p vii)

In favour of the former point of view is the absence of any reference to Helmholtz either in the papers of Gaugain (*Comptes rendus*, 36, 191–193 *Ann d Physik*, [2], 88, 442–446, 1853 *Ann de chim et de phys*, [3], 41, 66–71, 1854) or in the supporting note by Bravais (*Comptes rendus*, 36, 193–197 *Ann d Physik*, [2], 88, 446–451, 1853) Furthermore, we have the much quoted statement by Clerk Maxwell 'Helmholtz converted Gaugain's galvanometer into a trustworthy instrument by placing a second coil, equal to the first, at an equal distance on the other side of the magnet' ("Treatise on Electricity and Magnetism", vol 2, p 318, 1873, 2nd ed, vol 2, p 327, 1881, 3rd ed, vol 2, p 356, 1892) This, it will be observed, considerably antedates Wiedemann's note on the subject Helmholtz, so far as I can find, made no claim on his own account at any time

A less direct but even more convincing argument in favour of Gaugain's priority is furnished by the following facts F E Neumann, a great authority on Ampère's discovery and its applications, was at Königsberg when Helmholtz went there in 1849, so that they were colleagues during the period when, if ever, Helmholtz anticipated Gaugain We learn from a paper by H Wild (*Vierteljahrsschr d naturf. Ges in Zürich*, 2, 239, 1857) that Neumann lectured on two-coil and four-coil combinations at least as early as 1856 In a transcript of Neumann's

Vorlesungen über elektrische Ströme", as given in 1864–65, published with his permission in 1884 by K Vondermühl, we find on p 197 a careful reference to Gaugain (the only reference in a 36 page chapter) and no mention of Helmholtz

This letter is written in the hope that some reader of NATURE may have additional evidence to offer If none is forthcoming, I think we should call the two coil combination Gaugain Helmholtz coils If the whole truth were known, it seems probable that the proper designation would be Gaugain Neumann

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April 11

The Apparent Thermionic Constant *A* of Clean Metals

THERE seems to be little room for doubt that the apparent thermionic *A* (the *A* derived from a Richardson line) of at least some clean metals is genuinely less than the upper theoretical limit for this quantity, A_0 the value of which is 120 amp cm^{-2} deg^{-2} Thus, for tungsten, tantalum and molybdenum, which are among the metals for which the most reliable data are available, values of 60 100, 60 and 55 amp cm^{-2} deg^{-2} respectively have been obtained, and, if surface roughness had been taken into account, somewhat smaller values still must have been found It would, of course, be quite possible to attribute these results to an imperfect transmission of the electrons through the emitting surfaces, assuming the apparent *A* to be the true *A* There is however, a known effect which, unless compensated for by other effects, must make the apparent *A* less than the true *A* by a factor of at least 2 or 3, and which would therefore, account for the order of magnitude of the observed data on the assumption of practically perfect transmission

It is well known that the apparent *A* will differ from the true *A* if the work function χ varies with the temperature According to Sommerfeld's theory of metals, this quantity is given by the equation

$$\chi = C - \frac{h^2}{8m}\left(\frac{3n}{\pi}\right)^{2/3},$$

where C, h m and n are the product of the inner potential and the electronic charge, Planck's quantum of action, the electronic mass, and the number of effectively free electrons per unit volume of the metal respectively Strictly speaking, there should be a further term in the expression for χ, but with ordinary free electron concentrations this is small and its temperature dependence makes the apparent *A* differ from the true *A* by only something like 2 per cent Apart from this, χ might vary with the temperature, as Fowler[1] has pointed out, owing to a temperature variation either of C or of n Concerning what variation of C with temperature is to be expected, little, unfortunately, seems to be known There must, however, be a temperature variation of n associated with the thermal expansion of the metal, if, as is probable, the number of free electrons *per atom* remains constant. It appears worth while, then, to see whether the experimental data might be accounted for by assuming that C is sufficiently nearly constant for the temperature variation of χ to be determined in direction and order of magnitude by that of n alone

Let the coefficient of linear expansion be denoted by α Then from the formula for χ we find that the corresponding factor, f, by which the apparent *A* must be less than the true *A* is given by

$$f = \exp\left\{\frac{h^2\alpha}{4mk}\left(\frac{3n}{\pi}\right)^{2/3}\right\}.$$

In the temperature regions where thermionic measurements are usually made α has the value 6 3$\times 10^{-6}$ deg^{-1} for tungsten and 8 0$\times 10^{-6}$ deg^{-1} for both tantalum and molybdenum On the assumption of one free electron per atom the values of n for the three metals in the order named would be 6 2$\times 10^{22}$, 5 6$\times 10^{22}$ and 6 3$\times 10^{22}$ per cm^{3} respectively Hence for the corresponding values of f we should have 2 3, 2 7 and 2 9 respectively For two free electrons per atom we should have, instead, 3 7, 4 3 and 4 6 respectively These are of the order of magnitude of the factors by which the apparent *A* values fall short of A_0

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General Electric Company Ltd,
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April 30

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[1] R. H. Fowler *Proc Roy Soc* A 122 36, 1929

Isomeric Nuclei?

As I have shown elsewhere[1], the introduction of negative protons into nuclear structure leads to the possibility of the existence of isomeric nuclei, that is nuclei with the same atomic number and atomic weight but different internal structure (a pair of positive and negative protons instead of a pair of neutrons) As an example the nucleus of uranium Z was given, which seems to be isomeric with uranium X_2

A further indication is furnished by recent measurements of Aston[2], who has found in the mass spectra of ordinary lead the line 210 This isotope of lead has the same atomic number and atomic weight as radium D but, since it exists to the extent of 0 08 per cent, it cannot be, of course, the usual radioactive radium D Therefore, if the ascription of the observed line to lead is not erroneous, we must conclude that the nucleus with atomic number 82 and atomic weight 210 may exist in two modifications (isomers) of which one is stable and the other is subject to β decay

G GAMOW

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April 25

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[1] G Gamow *Phys Rev* (in print)
[2] F W Aston *Proc Roy Soc* A 140 585 1933

Ground State of C_2 and O_2 and the Theory of Valency

ACCORDING to the quantum mechanical theory of the chemical bond in its original form, the lowest state of a diatomic molecule should be a singlet term The ground states of C_2 ($^3\Pi_u$) and O_2 ($^3\Sigma_g^-$) found experimentally seem to be in contradiction with this theory while other considerations (Hund, Mulliken, Lennard-Jones) lead to the right result

But it can be seen that the above mentioned theory also easily explains the experimental facts One has only to take into account that the binding energy of the molecule is not only due to the interaction of the ground states of the atoms, but is also effected by slightly excited atomic states For C_2 and O_2 one has to consider besides the ground states (^3P) the ^5S state of C and ^1D of O

It is well known that two potential curves with the same symmetry interact strongly if their separation is not too large In this case they repel each other so that one of the curves is strongly depressed and becomes very low

For C_2, the configuration $^3P - {}^3P$ (both atoms in the ground state) gives rise to singlets and triplets one should expect the lowest to be a singlet But from the configuration $^3P - {}^5S$ (one atom excited) only triplets result Therefore, because of the above mentioned interaction, just the triplet terms will be depressed By Slater and Pauling s method concerning the overlapping of eigen functions it can be seen that the strongest interaction exists between the two $^3\Pi_u$ terms So one of them becomes very low and a rough calculation shows that it probably lies still lower than the $^1\Sigma_g^+$, the lowest of the $^3P - {}^3P$ configurations, so as to become the ground state of the molecule in agreement with experiment

The same considerations can also be applied to O_2 From the configuration $^3P - {}^1D$ only triplet terms result The $^3\Sigma_g^-$ terms have the strongest interaction giving the fundamental state of the molecule[1]

W Heitler
G Pöschl

H H Wills Physical Laboratory,
University of Bristol
May 7

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[1] Similar considerations for the explanation of the BeH molecule have already been applied by C Ireland *Phys Rev* 43 329 1933

Pupation of Flies initiated by a Hormone

Dr V B Wigglesworth reported in Nature of May 12 on the detection of a hormone which initiates moulting and pupation in a tropical bug In the pupation of flies a very similar principle is acting according to experiments carried out by me during the past few months Prepupæ of the blow fly *Calliphora erythrocephala*, were ligatured securely into two parts If the ligature was laid down not more than about 12 hours before pupation, both parts pupated, the anterior part preceding the posterior part usually by 1 to 3 hours But if the prepupæ were ligatured more than 12 hours before pupation, then either the anterior pupated alone, within 12 to 48 hours or both parts failed to pupate

In the fly larvæ all the ganglia are concentrated in a single mass in the anterior part of the body, so that by ligaturing, the posterior part is disconnected from the nervous centres It is, therefore shown that the separation of the nervous centres does not prevent the posterior part from pupating, if the separation took place only a short time before pupation From these experiments it can be concluded that something in the anterior part initiates or induces the pupation The isolated posterior part is able to pupate only if the induction by the anterior part was already accomplished before the ligature was laid down

This induction may consist of a nervous stimulus, brought to the skin by the nervous system, or it may be accomplished by a special hormone, secreted in the anterior part and carried about in the body by the blood The following experiments show that the latter alternative is the true one:

(1) Prepupæ are securely ligatured more than 12 hours before pupation and the ligature is taken away after about 15 min In these specimens the nervous conduction between the two parts of the body is interrupted but the blood circulates through the whole body When pupation takes place, it occurs in the whole body simultaneously

(2) The blood of prepupæ which are about to pupate is injected into posterior parts of younger prepupæ the anterior part of which was ligatured off about 24 hours before These posterior parts would never have pupated without the injection Of the injected posterior parts about 50 per cent pupated In certain cases they pupated only when a second injection was given 24 hours after the first

The localisation and identity of the organ which produces the hormone are being investigated

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May 16

Crossing-over in the Land Snail *Cepæa nemoralis*, L.

A genetic situation of particular interest from the point of view of the evolutionary modification of genetic phenomena occurs, not only among fishes (*Lebistes*, and other genera) but also among insects (Orthoptera) and land snails (*Cepæa*) in all of which a number of variant genes completely dominant to their recessive allelomorph, are found to be closely linked in the same linkage groups In the grouse locusts, the linkage was so close as to be equivalent to a single allelomorphic series The occurrence of an outlier of the main group showing only moderate linkage with it was demonstrated by Haldane in the extensive data published by Nabours Nabours has since shown that in one American species of grouse locust (*Acrydium arenosum*) a similar series of pattern factors occurs, showing high frequencies of crossing over

In the course of experiments at the Galton Laboratory, designed to test quite other consequences of natural selection, a brood of *Cepæa nemoralis* has been obtained recently showing apparently 20–25 per cent recombination between the factor for a pink (v yellow), and that for bandless The brood of about sixty young appeared in the summer of 1933, the parents having been taken in Nature about 15 and 28 months previously The pink bandless double heterozygote was evidently in coupling phase, for there survived to be classified in April of this year 17 bandless pink, 18 banded yellow or 35 of the parental combinations, together with 4 banded pink and 5 bandless yellow, making 9 recombinations, evidently due to crossing over

The occurrence of close linkage between a number of genes in natural populations of *Cepæa* has long been recognised[1] though the actual data have not yet been published The unpublished genetic results of A W Stelfox, kindly placed at the disposal of one of us (C D), include a similar back cross between pink bandless and yellow banded, which gave 13 pink bandless and 11 yellow banded, followed by a second generation from bandless pinks of 16 pink bandless and 10 yellow banded Neither of these progenies show recombination, and they are inconsistent with the occurrence of so much as 20 per cent It seems likely that the pinks used in the two sets of experiments were genetically different, and that one is more closely linked with bandless while the other shows appreciable recombination The alternative that the same genes may show variable linkage in different strains is, however, not excluded

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C DIVER

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May 9

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[1] Diver C Proc Sixth International Cong Gen 2 236 1932

Crystalline Œstrus-producing Hormone from Horse (Stallion) Urine

PROF B ZONDEK[1] has published results on the high quantities of oestrus producing hormone present in horse (stallion) urine By application of the method employed in this Institute for the preparation of crystalline oestrogenic hormones from the urine of pregnant mares a few milligrams of crystals of high oestrogenic activity were obtained from 5 litres of horse urine

They were rhomboid plates, melting after recrystallisation from alcohol at 254°-255°, and when mixed with a sample of α folliculin (α oestrone) melting at 257° 259° the melting point of 254°-256° was obtained

As predicted by Zondek by the comparison of the physiological properties, the isolated substance seems to be identical with the hormone of the urine of pregnant women Greater quantities of horse urine are now being worked in order to identify the hormone with certainty

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April 30

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[1] NATURE 133 209 Feb 10 494 March 31, 1934

Crocodiles or Alligators?

THERE has recently been published the part of Das Tierreich" dealing with Reptilia Loricata, and since this great work is bound to be widely used by zoologists in the naming of species, it becomes of considerable importance in the stabilising of zoological nomenclature One therefore examines with more than usual interest the generic and specific names adopted by Dr Franz Werner for crocodiles and alligators Again the strict application of the laws of priority in nomenclature gives rise to some confusion The generic name *Crocodilus*, as applied to Old World crocodiles (Crocodilidæ) by Cuvier in 1807, is replaced by *Champse* of Merrem (1820), the reason being that in 1768 Laurenti had used the name *Crocodylus* with another significance

Following Laurenti's usage the name *Crocodylus* is accordingly applied to two South American species of alligators, so that, in the first place, confusion arises between the old-established distinctions between crocodiles and alligators, and, in the second place, the family name Crocodilidæ (although still retained) loses its significance, since it no longer includes the genus *Crocodilus*

More unfortunate still, the specific name of the tropical South American alligator, widely known as *trigonatus*, has following Laurenti, become *Crocodylus niloticus* so obvious a misnomer that its meaning can only lead to confusion

My impression is that the laws of priority provide against the perpetuation of obvious mistakes, in any case if Laurenti more than a century and a half ago, made the blunder of naming a South American form under the impression that he was naming a specimen from the Nile there seems to be no good reason why the blunder should be stabilised in a scientific system It is on a par with, though more confusing than the retention of the name *Certhia familiaris brittanica* for the British tree creeper because Ridgway forgot for a moment how to spell Britain

Sine systemate chaos is the motto printed on the cover of Das Tierreich , but confusion may arise under the cloak of systematics

JAMES RITCHIE

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May 8

Air-Pockets in Shore Sands and Winter Packing of the Sea-Bottom

WHILST crossing the Lancaster sands last summer from the village of Flookborough my attention was attracted by a succession of curious sounds all around me, resembling either profound sighs or the strong flat expirations made through pursed lips by a sleeping person These sounds were first heard in daylight, but they may have been heard at night in the past by others and given rise to tales of legendary monsters On searching for the cause I was at once shown it by my companion Mr Thomas Wilson the sounds were due to the escape of air from small pockets below the surface of the wet sand, and could be produced by perforating with one's finger the drying and slightly elevated areas of sand overlying the pockets The vibration produced in the ground by a pedestrian or a passing cockle-cart appears to increase the air pressure sufficiently to blow off the sandy caps of the pockets

It occurred to me that the holes and cavities formed in the sand might be of interest to geologists, since similar ones might have become fossilised in past ages and remain to perplex the palæontologist

These air pockets have been observed near high water mark when crossing the sands soon after the recession of the tide, the following explanation is suggested for their formation At this level the sand dries and drains to a great extent in summer, and especially during the neap tide period When the spring tide floods set in, water flows very rapidly over the area of dry sand, imprisoning air below the wetted surface During high and the following ebb tide water gradually percolates below the surface into the underlying sand, driving the imprisoned air into the looser aggregations of sand where it collects and forms a pocket, which may be blown' by a gradual accumulation of the encircling water pressure or by a sudden increase due to vibration of the ground

These miniature air volcanoes were noticed frequently during the summer, but not during monthly visits in the winter In April this year they have again appeared This apparent periodicity is interesting in connexion with the prevailing view held by British inshore fishermen that the sea bottom on the fishing grounds becomes hard or 'closes up' in winter and loosens or 'opens up' again in the spring: confirmation of this observation—important in quantitative studies on fish and fish food—offers a difficult problem for the biologist The Flookborough sands appear 'harder' in winter, but this may be due to lack of drought and drainage, factors which would not, however, operate below sea level Whether the fisherman's hardening of the sea bottom might be due to biological phenomena, such as a relative quiescence of the in fauna, or to physical causes, remains to be sought

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May 11

Strange Sounds from Inland Ice, Greenland

DURING the month of August 1932 when setting up the French Expedition of the International Polar Year in Scoresby Sound, on the East Greenland coast, some of my colleagues and I heard four times the mysterious sound called by the late Prof A Wegener the 'Ton der Dove Bai'[1] The sound was heard in the morning, generally at 11 a.m (G.M T), and also during the afternoon It was a powerful and deep musical note coming far from the south, lasting a few seconds It resembled the roaring of a fog horn After that it was not heard during the course of the Polar Year

A Wegener and five of his companions heard it eight times in five different neighbouring places, both during the day and the polar night It lasted some times a few minutes and Wegener ascribed it to the movements of inland ice In fact it seemed, in Scoresby Sound, to come from beyond Cape Brewster, precisely from the part of the coast where the inland ice flows into the sea from the large glaciers

Is this vibrating sound really caused by the detachment of icebergs or is it similar to the desert song', that strange musical note produced by the sand? In fact, there is a close analogy between the fields of powdery dry snow of the inland ice and the fields of sand of the Arabian desert

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[1] J P Koch und A Wegener Meddelelser om Grønland Bd 75, 314 1930 (Dove Bay 76½° N 20° W)

Spearman's General Factor without the Indeterminate Part

IT is well known that Spearman's two factor theory of intelligence leads to an expression for the general factor g containing an indeterminate part[1] Considerable discussion has taken place on the inconvenience so caused I have proved that if we adhere strictly to the conditions laid down by Spearman, namely, that the general factor and the specific factors are all mutually uncorrelated, we cannot dispense with the indeterminate part[2]

However the problem can be stated in another way, which seems likely to prove much more convenient in practice Let us define the *approximate* general factor g^1 as the determinate part of the formula obtained for g (with a slightly different multiplier so as to keep the standard deviation unity), with a similar definition for the approximate specific factors Then I have proved that these approximate specific factors are all approximately uncorrelated with each other and *exactly* uncorrelated with the approximate general factor For Brown and Stephenson's results no coefficient of correlation of these approximate specific factors is numerically greater than about 0 1

A detailed proof will be offered for publication elsewhere

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April 25

[1] *Brit. J Psychol.*, 24, 88 1933

[2] Lecture to Manchester Mathematical Society Feb 14 1934 (unpublished)

The Reaction between Oxygen and the Heavier Isotope of Hydrogen

WE have made a preliminary survey of the principal respects in which the reaction of deuterium with oxygen differs from that of ordinary hydrogen The deuterium was prepared by the nearly quantitative decomposition of 97 per cent deuterium oxide by repeated passage over pure iron The reaction with oxygen was studied by methods which have been used in this laboratory in a number of previous investigations of the normal hydrogen–oxygen reaction All experiments with deuterium were made in alternation with blank experiments carried out sometimes with cylinder hydrogen and sometimes with hydrogen made from water in the apparatus used for preparing the deuterium No differences between these different specimens of normal hydrogen were found

The results may be summarised as follows –

(a) With deuterium the chain reaction occurring in the gas phase at 560° and pressures greater than the upper explosion limit has a speed 64 per cent of that shown by hydrogen

(b) For the surface reaction occurring in a packed vessel at 525° the ratio of the rates for deuterium and for hydrogen is approximately 0 65–0 70

(c) The upper explosion limit is higher with deuterium than with hydrogen Our results here correspond to those of Frost and Alyea[1], which appeared during the course of the present work The shifting of the limit is almost exactly what would be predicted from the theory of deactivation by ternary collisions Deuterium, on account of its smaller speed, is a less efficient deactivating agent Using the formulæ given by Grant and Hinshelwood[2] we find that to account for the observed shift of the limit at 550°, 525° and 500° respectively, the values required for the relative collision frequencies of deuterium and hydrogen are 0 67 0 76 and 0 76, the mean being 0 73 The value calculated from the respective molecular weights, assuming equal collision areas, is 0 74 This is, indeed, a good confirmation of the ternary collision hypothesis itself

For the energy of activation of the branching process we find 26,500 calories, which does not differ significantly from the values 25,500 and 26,500 found for hydrogen

From the fact that the effect of the deuterium can be calculated from its speed as above, we must conclude that there is little difference in the actual probability of chain branching with the two isotopes If, as has been suggested[3], the branching depends upon whether at a certain stage of the chain H_2+HO_2 gives $H+H_2O_2$ or $H+2OH$, it will be determined by the breakdown of H–O–O–H into 2OH Then, since no link involving H or D is broken the different zero point energies of the two isotopes will have only a second order effect or none as found In the surface reaction and the steady chain reaction the rates depend not upon simple branching but upon initiation and propagation mechanisms one or other of which must involve the activation or dissociation of H_2 or D_2 The different zero point energies will then give rise to different activation energies and hence to different rates in accordance with observation

It appears therefore that the study of the behaviour of the heavy isotope brings from a somewhat unexpected angle an interesting confirmation of several matters connected with the mechanism of the reaction

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J Amer Chem Soc 56, 1251 1934

[2] *Proc Roy Soc* A 141, 29 1933

See Hinshelwood and Williamson The Reaction of Hydrogen with Oxygen (Clarendon Press 1934)

Photochemistry and Absorption Spectrum of Acetone

IN a recent letter[1] we noted that the ultra violet absorption band of acetone which earlier workers[2] (with the apparent exception of Herzberg[3]) had regarded as continuous has a fine structure This occurs in the long wave side of the band Bowen and Thomson[4] now record a resolution of the remainder of the band into about four groups each containing about 25 diffuse bands but conclude that the diffuseness of the bands can be attributed to an unresolved close packing of the rotation lines without calling on the additional hypothesis of predissociation In citing the fluorescence of acetone as evidence of the absence of dissociation they make no reference to the fact that it is confined to the longer wave lengths of the absorption band[5] Actually the fluorescence disappears near the wave length at which the line structure noted by us becomes diffuse and while this abrupt change can be readily explained by the onset of dissociation it is not accounted for by the assumption that the diffuse region consists of close packed rotational lines

For the photochemical decomposition of acetone Bowen and Thompson adopt the mechanism which we suggested for the decomposition of aldehydes[6] namely a unimolecular elimination of carbon monoxide according to the equation $R\,CHO \rightarrow RH + CO$ They make no reference however to the different behaviour of methyl ethyl ketone[7] which gives a mixture of ethane propane and butane in comparable quantities instead of only propane This crucial fact is not explained by the hypothesis which they have adopted but is readily understood if the hydrocarbon chains are liberated as free radicals

The photodecomposition of methyl butyl ketone[8]

$$CH_3CH_2CH_2CH_2\,CO\,CH_3 \longrightarrow CH_3CH\;CH_2 + CH_3CO\,CH_3$$

is in complete contrast with that of acetone and was quite unforeseen by us, it would be of interest to know on what grounds these authors are able to regard it as 'not unexpected The initial electronic excitation of the chromophoric group will undoubtedly be associated with various vibrations of the molecule including the deformation vibration mentioned by Bowen and Thompson but in our opinion the energy associated with these vibrations is much too small to account for the decomposition of the butyl chain which in the analogous case of butane requires an activation of 65 k cal'

It may now be suggested that the energy of excitation passes from the chromophoric group to another group within the polyatomic system by a process akin to the radiationless transfer in a collision of the second kind This process which we shall describe as inner sensitisation need not give rise to a quantum yield of unity In a complicated molecule there is likely to be a finite probability that the energy transfer may lead to thermal degradation instead

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April 23

Crone and Norrish, NATURE 132 241 Aug 12, 1933

See footnote in paper by Scheibe Povenz and Lindström *Z phys Chem*, B 20 297 1933

Scheibe and Lindström *Z phys Chem*, B 12 387 1931 Damon and Daniels *J Amer Chem Soc* 55 2363, 1933

Bowen and Thompson, NATURE 133 571, April 14 1934

Norrish and Appleyard *Trans Faraday Soc* 30, 103 1934

Norrish and Kirkbride *J Chem Soc* 1518 1932

Pease and Durgan *J Amer Chem Soc* 52 1262 1930

Chemistry of the Red and Brown Algæ

SOME experiments of ours confirm the results of Dr Russell Wells on the presence of true cellulose in algæ[1] From Laminariæ we obtained cellulose from which we made viscose and which we converted into sugar by the method of Ost This sugar gave phenylglucosazone but no trace of insoluble phenyl hydrazone (indicating mannose) was found

We were led to these experiments by the well known occurrence of mannitol in seaweeds and by the demonstration by Nelson and Cretcher[2] that algin is a polymerised uronic acid Evidently whatever uronic acid occurs in the plant the unit of the cell wall material remains the same

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T O TUAMA

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May 10

NATURE 133 651 April 28, 1934

[2] *J Amer Chem Soc* 51 1914 1929

Phosphorescent Beryllium Nitride

ALUMINIUM nitride activated by silicon[1] and boron nitride activated by carbon[2] are the only known phosphorescent nitrides

Phosphorescent beryllium nitride has been obtained by me by passing ammonia gas at 1 000° C for four hours over a mixture of beryllium metal containing ten per cent alumina The product thus obtained shows blue luminescence after exposure to a mercury arc lamp

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April 17

E Tiede Max Thomann and K Sensse, *Ber* 61B 1568 1928

[2] E Tiede and F Buescher *Ber*, 53B 2206, 1920 E Tiede and H Tomaschek *Z Elektrochem.* 29, 303 1923 E Tiede and Heuriette *Z anorg Allgem Chem* 147 111 1925

Research Items

Irradiated Yeast and Rickets. Although a number of questions relating to the action of vitamin D still remain unsettled, the fact that irradiated ergosterol determines the fixation of calcium in the animal organism and hence induces good ossification has been indisputably demonstrated In almost all countries this particular form of prophylaxis is practised by administering definite doses of the irradiated ergosterol dissolved in olive, arachis, sesame, or other oil In discussing this subject before the Royal Lombardy Institute of Science and Letters (*Rendiconti* 66) Prof Ernesto Bertarelli points out that those ergosterol containing oils readily become rancid and have other properties which make them unsuitable as products to be applied extensively as prophylactics He emphasises the advantages of replacing these oily liquids by irradiated dry brewers' yeast, which is rich in ergosterol and easy to take, and remains unchanged over long periods The powdered yeast can easily be mixed with, for example, bread and milk in daily amounts of 0 5–0 75 gm , and the doses are simpler to handle and regulate than are small quantities of oils

Fauna of the Dutch East Indies The latest additions to the faunal studies in the Dutch East Indies ('Résultats Scientifiques du Voyage aux Indes Orientales Néerlandaises de LL AA RR Prince et la Princesse Léopold de Belgique ' *Mem Mus Royal d'Histoire Naturelle de Belgique* Hors Série 1933) are on the Sipunculidæ by J M A ten Broeke and Brachiopoda and Amphineura by E Leloup (vol 2 fasc 3) , on Holothuria by H Engel and Crustacés décapodes d Eau douce" by Jean Roux (vol 3, fasc 13 and 14) and Poissons ' by Louis Giltray (vol 5, fasc 3) Of those the most important is the last, occupying 129 pages and describing a large collection of specimens (850) many of which were caught at the surface by night or found among the corals There are 205 species, 6 of which are new to science A knowledge of the general distribution is much extended most of the species having a very wide range from the Red Sea to Polynesia It is very interesting to note that the fishes of this Indo Pacific zone seldom pass the Hawaiian Islands or Paumotu On the Pacific coasts of Central America one meets with a totally different fish fauna That part of the Pacific between these islands and the American continent seems to constitute an almost complete barrier to colonisation from the west The reason for this appears to be the surface temperature of the sea, as the American coast is bathed by two cold currents, one from the north and one from the south (the north and south equatorial drifts), both taking cold water towards Polynesia the salinity being very much lower than in the Indo Pacific zone and thus a natural barrier is formed for eggs and the young stages of fishes The separation between America and Indo Australia is very ancient, but the Indo Pacific zone has undergone a series of successive continental formations and possesses physical characters suitable for a somewhat homogeneous fauna throughout its whole area, the main centre of dispersal apparently being the Indo Australian archipelago

Gill Movements in the May-fly Nymph An interesting addition to our knowledge of propulsion mechanisms in animals comes from Prof L E S Eastham (*Proc Roy Soc* , B, 115, 30), who has analysed the gill movements in the nymph of the may fly, *Cænis horaria* In this insect the four pairs of gills beat in a normal (longitudinal) direction, but work in such a manner as to produce a current that is transverse The direction is reversible, and no permanent functional asymmetry is involved The gills on one side are found always to be out of phase with those of the other, but, though of some importance this phenomenon proves to be not the only factor concerned in the production of the transverse current Indeed, analysis revealed that several factors were conspiring to that end, involving at least three different mechanical principles The up and down movement of the gill in an elliptical path with the convex side above, and the gill fringe closing on the downward stroke recalls the action of a bird s wing , the change of angle of the gill to the direction of flow brings about what is essentially a screw action while the alternate suction and compression between both successive gills and members of each pair, caused by the metachronal rhythm, has an effect comparable with that of the limb movements in the filter feeding *Cheirocephalus*

A Foliar Endodermis and the Function of the Endodermis Almost throughout the vascular plants, the vascular system of the young absorbing root is enclosed within an endodermis, and the fact that this means that the stelar sap is enclosed within a cylinder of living protoplasts embedded in the peculiar network formed by the Casparian strip has been interpreted as the mechanism determining the osmotic entry of water into the stele Further experimental examination of the passage of solutes across the endodermis has therefore considerable significance, and George Trapp has recently used the foliar endodermis of the Plantaginaceæ, having made a thorough study of its structure and distribution, for a re-examination of its behaviour in retaining solutes Using relatively high concentration of non toxic dyes which were absorbed by cut shoots of *P arborescens*, very definite results could be obtained in comparatively short periods of time Dyes the diffusion of which is confined to the cell membranes were prevented from outward diffusion from the veins wherever the endodermis was present Trapp's experiments are described and discussed, after a discussion of the structure and distribution of the foliar endodermis in this family, in the *Transactions of the Royal Society of Edinburgh*, 57, part 2, No 18, 1933

Preservation of New Potatoes The popularity of the new potato has led to investigations being carried out as to the possibility of devising some method of storage so that the characteristic flavour will be retained Interesting results of experiments on these lines are described by A M Smith in the *Scottish Journal of Agriculture*, 17, 202 Since the thin skin is one of the most highly valued properties of the new potato, immaturity at the time of lifting is essential This is preferably achieved by anticipating the ordinary harvest by about a fortnight, as late planting (the other alternative) is liable to expose the crop to bad climatic conditions Storage of such immature potatoes clearly requires special treatment, as they are more liable to mechanical injury and show a greater respiratory activity than mature tubers. The greatest measure of success was achieved by the following method, attention to conditions of temperature and humidity proving of the first importance. The tubers were packed in ordinary fruit barrels of 2–2½ cu. ft. capacity and stored in a cellar at a temperature of about 40° F. The barrels held 40–50 lb. of potatoes placed in six or seven layers interspersed with a packing mixture of approximately equal volumes of granulated peat and sand, the moisture content averaging between 10 and 12 per cent. The peat helps to retain the moisture while the sand aids aeration. The presence of 1 per cent calcium carbonate appeared to reduce the tendency to sprout in some cases, but both this method and the addition of apples (also claimed as a deterrent to sprout development) need further study before conclusive evidence is obtained. As regards the best variety to use, King Edward appears to fulfil the necessary conditions most nearly, but it is probable that further trial will show that many other varieties are equally suitable.

Grassland and Grazing. An interesting résumé of the experiments on grassland management carried out at Jealott's Hill by Mr. Martin Jones is given in the 1933 issue of the *Journal of the Royal Agricultural Society*, vol. 94. Provided a pasture lies on an adequately drained and limed soil and maintained at a satisfactory level of fertility, the character of the sward can largely be controlled by the grazing methods adopted. In the case of grassland newly sown with a simple mixture of grasses and clover, the latter could be obtained as the dominant if close grazing were carried on from March until May, competition with the earlier growing grasses being thereby avoided. On the other hand, if heavy stocking was always avoided and no grazing at all allowed before mid-April, grasses could be secured as the dominant feature. An intermediate result was brought about by resting the field up to April and then alternating close grazing with intervals of a month's rest. Overstocking in the winter and understocking in the summer induced the poor weedy condition which is of only too common occurrence on farms in general. Similar differential results were obtained with an old established pasture, where equilibrium had apparently been reached for a number of years, the rapid increase in rye grass and clover and the reduction of weeds being specially noticeable. Individual species of grass could also be encouraged at will, the predominance of rye grass or cocksfoot, for example, depending chiefly on the time of year at which the field was rested.

Gemstones. The latest of the series of handbooks on 'The Mineral Industry of the British Empire and Foreign Countries" published by the Imperial Institute is one on "Gemstones" (137 pp. 2*s*. 6*d*.) which summarises in a handy form the economic and statistical information available on this subject. The introduction deals, in a popular style, with the physical characters on which the beauty of the stones depends and mentions the methods used for identifying different species. A description of the various minerals and their modes of occurrence is followed by an account of the methods adopted for cutting and polishing the stones. The main part of the book deals with each producing country, describing the stones obtained, the location, type and extent of the deposits and the method of working. Technical data for the expert and interesting information for the gem lover are also provided. A useful list gives the London prices for cut gemstones of various qualities and weights. About five sixths of the world's annual output of diamonds is produced in the British Empire, which is also well furnished with supplies of other important stones. Australia contributes opal; India, Burma and Ceylon provide jade, sapphire, ruby, spinel, agate, garnet, tourmaline, chrysoberyl, zircon, moonstone and the various forms of quartz; South West Africa yields tourmaline and beryl and South Africa has deposits of beryl and emerald. The volume should be read by all interested in gemstones and in the gem industry.

Saxton's Maps of England and Wales. The county maps of England and Wales by Christopher Saxton published between 1574 and 1579 provided material for English maps for a long period, but very little is known of the method Saxton used in compiling his sheets. In many of the sheets there are certainly striking omissions of physical features large enough to be shown on the scale used. Mr. G. Manley has studied the problem in certain of the Pennine sheets and makes some interesting suggestions in a paper in the *Geographical Journal* of April ('Saxton's Survey of Northern England'). Mr. Manley finds that Saxton's choice of hills to be marked was dictated by several reasons: historic names, sources of streams, beacon hills, boundary hills and lastly a category of hills that are characterised if anything by the extent of the view which they offered from the summit but not necessarily by great height. These would appear to be hills which Saxton or his assistant climbed. He may have gone up other hills but it is unlikely. Certainly his river valleys are often incomplete at their heads. From the hill tops he reached, Saxton seems to have estimated distances along single bearings. He was careful about detail in well inhabited lands, but worked rapidly in uninhabited country, where his maps are weakest, especially when he surveyed by this method a rugged land like the northern Pennines and Lake District, where much detail at lower altitudes was hidden from his elevated viewpoints.

A New Objective for X-Ray Cinematography. A new objective specially computed for X-ray cinematography has been produced by Messrs. Carl Zeiss and is described in the *Zeiss Nachrichten* of April 1934. This lens has several unusual features which are of interest. For the cinematography of the fluorescent screens used in X-ray work a very fast lens is required on account of the small amount of light available. The new lens, the *R* Biotar, has an aperture of *f*/0.85, which is larger than that of any satisfactorily corrected lens previously available. In computing it, special attention has been given to the reduction of spherical aberration, which judging by the details given has been very successfully done. The lens has, however, no depth of focus, and a very narrow field, neither of which defects is important for the purpose for which the lens is to be used. With such a large aperture the dependence of the correction on object distance is very large, so that in its normal form the lens can only be used when the distance of the object is large compared with the focal length A special lens has been designed for use in sound film work where closer objects are used On account of its unusual proportions, the lens, which is made for both standard and substandard cinematography, can only be used in existing cameras after alterations have been made to the latter Moreover, no iris diaphragm is provided as this would still further increase the difficulty of using it in existing cameras With such critical focusing as is required, it is necessary to ensure that the film lies perfectly flat and that successive frames come into exactly the same place The light emitted from the fluorescent screens used lies almost entirely within the visible region, and the transmission of the lens in this region is very good although 30 per cent of the incident light is lost by reflection at the glass air surfaces This lens in combination with modern high speed photographic emulsions makes possible X ray cinematography at a picture frequency approaching that normally used

Trichromatic Reproduction in Television In a paper read before the Royal Society of Arts on May 2, Mr J C Wilson gave an account of some experiments that have been conducted in the Baird television laboratories in an attempt to develop a television system in which the transmitted scene is reproduced at the receiver in colours The scanning at the transmitter and receiver was accomplished by the use of a scanning disc with three spiral segments, each segment containing 15 holes The three segments were responsible for the red green and blue components of the picture respectively, and by rotating the disc at 600 r p m the image was scanned 30 times per second in all, 10 times per second in each colour The system is thus a trichromatic system in which the three colours are presented successively and fused owing to the persistence of vision, only one channel between transmitter and receiver is therefore required The holes in the scanning disc were covered with the appropriate coloured gelatine filters, and the photoelectric cells at the transmitter were selected to give a satisfactory balance between the three sets of signals The light sources at the receiver comprised a neon lamp and a mercury vapour lamp While the colour quality of the reproduced image was apparently quite good, the definition with only 15 lines was very crude and any extension of the method is limited by the limitations inherent in mechanical scanning devices The work was, however, mainly intended to investigate the nature of the problem and the difficulties that have to be overcome

Removal of Sulphur Dioxide from Library Air It is well known that books and papers stored in cities where atmospheric pollution is high are in a uniformly poorer state of preservation than similar books and papers stored in country or suburban localities where the air is purer Experiments have shown that papers exposed to an atmosphere containing sulphur dioxide in an amount varying from 2 to 9 parts of sulphur dioxide per million parts of air for 10 days underwent pronounced physical and chemical deterioration, manifested by a large increase both in brittleness and acidity A valuable study of a method of removing sulphur dioxide from the air entering a library has recently been published by the Bureau of Standards, Washington (Misc Publications, No 142 5 cents) Tests were made in the Folger Shakespeare Library, Washington They show that the sulphur dioxide is not completely removed from the air by washing it with untreated water in an air conditioning system Effective elimination was obtained on washing the air with water that had been treated with alkaline material at a rate sufficient to maintain the hydrogen ion concentration of the wash water within the range 8 5 to 9 It was proved that the sulphur dioxide content of the washed air was entirely dependent upon the hydrogen ion concentration of the wash water The composition of a specific mixture of chemicals commercially available was found to be very satisfactory An air washer of the commercial type using untreated water does not remove enough of the sulphur dioxide from library air The hydrogen ion concentration should not be allowed to rise above *p*H 9 0 owing to the danger of removing zinc from brass fittings

Nessler's Reagent. An alkaline solution of mercuric iodide and potassium iodide, probably containing the compound HgI_2, 2KI, is Nessler's reagent and gives a brown colour or precipitate with ammonia The composition of the brown compound has been variously given since its discovery by Nessler in 1856 but in a recent study (Nichols and Willits, *J Amer Chem Soc*, April 1934) it is shown to have the composition represented by the empirical formula $NH_2Hg_2I_3$ The compound is very insoluble and tends to form in very minute particles, which are negatively charged and form a colloidal solution These particles can be separated by ultra filtration They are formed instantaneously in the reaction When ammonia solutions of higher concentrations are nesslerised, the yellow colour changes to red owing to agglomeration of the particles This may be prevented and the colour made permanent over a wider range of concentration of ammonia by adding a protective colloid, for example, by adding to 50 ml of Nessler solution 1 ml of a 0 5 per cent alkaline ash free gelatin solution containing 1 per cent of perhydrol The colour is of as great or a greater intensity than that produced in the standard method

Stellar Spectra of Type *B* A detailed study of the wave lengths, origins and behaviour of lines in *B* type spectra was made in 1931 by Dr Struve (noted in NATURE, 129, 442, 1932) Much work still remains to be done on these lines, and an important contribution has now been made by R K Marshall (*Pub Obs Univ Michigan*, 5, No 12) The spectra of 11 stars (the same as those discussed by Struve, with one exception) were measured over the range 3587 5047 A, with special attention to the near ultra violet They were all taken with the single prism spectrograph of the 37½ in Ann Arbor reflector Intensities of all measurable lines are given as found in each of the 11 stars (which range in spectral type from *O*9 to *B*8), together with the atomic symbol, when identified, and the laboratory wave lengths and intensities Of the 534 lines finally tabulated as genuine, only half have been even provisionally identified, and only about two fifths of these are considered as satisfactory identifications An interesting set of spectrophotometer tracings shows the differences between individual spectra as well as the main general features, and the variations of intensity with spectral type of the more important lines are also well marked

The Hawke's Bay Earthquake of February 3, 1931

THOUGH not in the front rank among the seismic regions of the world, New Zealand has been visited by several earthquakes with great crustal changes, such as those of 1823, 1848, 1855 and 1929 All these occurred in sparsely inhabited regions, and the death roll of New Zealand earthquakes has hitherto been small, the greatest loss of life before 1931 being that of 17 persons during the Murchison or Buller earthquake of 1929 For the first time in its history, New Zealand, on February 3, 1931, experienced an earthquake in the neighbourhood of important towns, the population of Napier being 16,025, and that of Hastings 10,850

The official report on the earthquake has recently been issued* It is the joint work of several writers The general account of the earthquake is given by Mr F R Callaghan, its geological aspects are described by Mr J Henderson, the director of the New Zealand Geological Survey, and the seismological phenomena by Dr C E Adams Mr M A F Barnett and Mr R C Hayes Mr P Marshall studies the effects of the earthquake on the coast line near Napier, and Mr S W S Strong the uplift in Sponge Bay In the concluding section, Messrs A Brodie and A G Harris report on the damage to buildings The whole volume is a notable contribution to our knowledge of an interesting earthquake

The east coast of the North Island, from Cape Palliser to East Cape, a distance of about 300 miles, is practically straight, except for the deep indentation of Hawke's Bay, 50 miles across Napier lies on the south west coast of the bay, Hastings about 12 miles to the south

The first known earthquake in the district since its settlement seventy five years ago occurred on February 23, 1863 Several houses in Napier were then destroyed On May 7, 1890, and again on August 9, 1904, the district was severely shaken by earthquakes with centres 180–200 miles south east of Napier On July 21 1921, there was a strong local earthquake with its centre about twenty miles inland During the next ten years, a number of slight or moderate shocks occurred either along an inland band or some distance out to sea, but the epicentral region of 1931 remained inactive

Suddenly, without any warning shocks, the great earthquake began at 10 17 a m on February 3 (February 2, 10 47 p m, G M T) The shock was in two parts The first part became rapidly stronger and was an uplifting movement combined with violent and confused swaying Then, after a pause of about 30 seconds, followed the second part with a motion resembling a sharp bump downwards The total duration was timed as 2½ minutes The number of known deaths was 256—161 in Napier, 93 in Hastings and 2 in Wairoa

The isoseismal lines, depending on the Rossi Forel scale of intensity, are reproduced in Fig 1 They show that the intensity decreased rather regularly with increasing distance from the epicentre, except towards the south west In this direction, the disturbed area reached so far as Timaru, 460 miles from the epicentre, while the shock was not felt at Auckland, only 200 miles to the north west The area of destruction, bounded by the isoseismal 9, is elongated, being about 100 miles long and 30 miles wide Within it is a smaller area of similar form, in which the intensity reached the highest degree, 10, of the scale

From the seismographic records at three stations (Arapuni, Wellington and Takaba), it was ascertained that the epicentre lay in lat 39° 20′ S, long 177° 0′ E This point, represented by the black spot in Fig 2, lies close to the west coast line of Hawke's Bay, about 12 miles north of Napier The same records give a focal depth of about 13 miles, which is approximately the same as that of several of the stronger after shocks

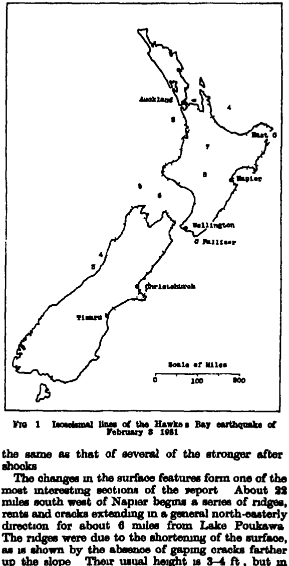

FIG 1 Isoseismal lines of the Hawke's Bay earthquake of February 3 1931

The changes in the surface features form one of the most interesting sections of the report About 22 miles south west of Napier begins a series of ridges, rents and cracks extending in a general north-easterly direction for about 6 miles from Lake Poukawa The ridges were due to the shortening of the surface, as is shown by the absence of gaping cracks farther up the slope Their usual height is 3–4 ft, but in places they rise 6–8 ft above the general surface They indicate that, as a rule, the country on the west side of the ridges moved relatively eastwards, and by an amount that, judging from the effect on the wire fences, must be measured in feet rather than in inches At one point, indeed, a road is displaced horizontally between 6 ft and 7 ft Still farther to the north are two other similar series of ridges The persistence of these ridges, along courses several miles in length, clearly points to movements along deep seated fractures

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* N Z, Department of Scientific and Industrial Research, Bulletin No 43 Report on the Hawke's Bay Earthquake (3rd February 1931) Pp. 116 (Wellington, N.Z Government Printer, 1933) 5s

After the earthquake, the uplift of the land was at once noticed at Napier and along the coast to the north Inland, however, it could only be traced by the rise of the bench marks Three lines of levelling were carried across the low lying plain to the south of Napier They revealed the existence of a line or narrow zone of no change, running south west from a point on the coast about a mile south of Napier, and parallel to the ridges near Poukawa, etc , described above The country north west of this neutral line was elevated as a whole, and that to the south east of it depressed, the greatest amounts shown on the sections being about 5 ft upwards and nearly 3 ft downwards The first series of levels was made between June and October 1931 In March and April 1932, the levellings were repeated, and these showed that, in the interval, the upraised mass had sunk as a whole and fairly regularly, the subsidence being most marked (a little more than a foot) at points where the previous uplift was greatest The re triangulation of the district revealed displacements of three points by 13 in , 13 in and 49 in

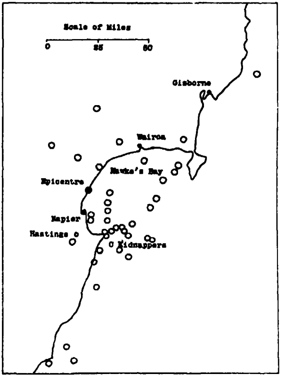

Fig 2. Hawke s Bay region Circles indicate epicentres of after-shocks of the earthquake of February 3 1931

The disturbances of the beach first become notable at a point 7 miles south of Napier At the north east corner of the Scinde Peninsula, on which Napier stands, the tide-gauge indicated a rise of 6 ft Between this point and the entrance to Port Ahuriri, to the west of the city, the uplift was manifest from the bleached remains of calcareous Algæ The Ahuriri Lagoon is shallow and its floor flat The outer margin was raised 6 ft. and the inner 3 ft 9 in As a result of this movement, wide areas of the lagoon floor have been laid bare at all states of the tide The total area of new land is estimated at about 5 sq miles Farther north, the uplift gradually increased from about 6 ft 6 in at a point 10 miles north of Napier to 9 ft at one 10 miles beyond Two miles to the north of the latter point, however, it seemed, though obscured, to decrease rapidly, until at and beyond a point 24 miles north of Napier, the uplift was too small to be discerned, with the exception of a small area to the west of the Wairoa River, in which there was a rise of about 2 ft

The floor of Hawke's Bay is regular, the depth of water increasing slowly outwards to about 8 fathoms at a distance of one mile After the earthquake soundings were made in the bay These showed a rise of about 6 ft , as on the adjoining coast Later in February, and again a year afterwards, further lines of soundings were carried out, but, beyond the reduction in depth by about 6 ft , it was clear that there had been no marked distortion of the sea bed

Assuming that the fracture traced on land crosses the floor of Hawke's Bay to the uplifted coast beyond it follows that the total length of the dislocation is not less than 40 miles a length comparable with that of the fissures formed with the earthquakes of 1848 and 1855 Mr Henderson thus concludes that, at the time of the earthquake an earth block, about 60 miles long in a north east direction and at least 10 miles wide at one place, was uplifted and that its central portion—and probably the whole block—was tilted gently and uniformly to the north west

One more phenomenon—and it is a most unusual one—may be noticed On February 17, or a fortnight after the earthquake some men were working on the beach of Tuamotu Island near Gisborne, when they witnessed the rapid uplift of a bank formerly covered by a foot or two at low water, to an average height of 7 ft They state that the reef ' just rose out of the sea without warning' The new reef is in Sponge Bay, 2½ miles from Gisborne, and has an area of about 2 acres Its surface is slightly dome shaped and is covered with large boulders At the same time, the adjoining land was depressed a few feet and broken into segments by numerous fissures No earthquake was felt with the movement, nor was any recorded in the adjoining district

The after shocks were registered at Wellington Hastings and elsewhere At the former station, 175 miles from the epicentre the numbers of shocks recorded were 151 on February 3, and, on successive days, 55 50, 29 24 21 12, and so on, until February 13, when there was a renewal of activity with 81 shocks, including one severe earthquake of intensity 8, with its epicentre 34 miles east of Napier From February 3 until March 3, the total number recorded was 612 During February, 590 shocks were registered at Hastings, the total number until the end of the year being 938 The epicentres of 40 after shocks from February 3 until the end of June 1932 were determined from the records These are indicated by the small circles in Fig 2 It will be seen that most of the after shocks originated beneath Hawke's Bay, especially in its southern portion Many of them are grouped along two bands, one running north from Cape Kidnappers, and the other in the east north-east direction from the same cape for 10–15 miles, and then striking north east right across the mouth of the bay C Davison

Exhibition of Technical and Scientific Chemical Apparatus at Cologne

THE Seventh Achema (Exhibition of Technical and Scientific Chemical Apparatus) was duly held at Cologne in the spacious and centrally situated permanent exhibition buildings on May 18–27. It is a testimony both to the importance of the exhibition itself and to the newer national development of the chemical industry in all countries that it was very largely visited by foreigners. More than 2,000 were expected, including a considerable and influential party of British chemical and chemical plant manufacturers, who spent several days in studying it and who are reported individually to have found the time well spent.

With past traditions to encourage her, Germany is striving to retain the lead which she formerly gained in this field, and although there was nothing particularly outstanding or novel on display, there was much among the exhibits of the three hundred firms to interest the serious. The method of display of the exhibits on small open stands of uniform character has much to commend it, and was thought by many to be preferable to the closed stands adopted at the British Industries Fair. Needless to say, the representatives at the stands were well versed in the technicalities of their wares and able usually to deal with technical points raised by the visitor, who frequently also found a willingness to discuss the special problems he brought forward at further private meetings or at the exhibitors' own works. The problems of the industry are so variable that standard apparatus has frequently to be modified to meet the particular requirements, and the Germans are known to be particularly adaptable in this respect.

The exhibits covered a wide field and were perhaps the more valuable in consequence, whereas the last exhibition of British chemical plant held in London, at the time of the jubilee of the Society of Chemical Industry, was restricted almost entirely to plant. Such collective displays as those made by the publishers of the many technical and scientific books were a feature that should be copied, as also the exhibit covering safety regulations and precautions in the industry. It is proper that chemists should be as meticulous in the treatment of the health and safety of their work people as they are of their reactions, and indeed it is well known that the industry is one of the safest in spite of the potentialities for danger in it.

The tendency, if there were one, was towards the exhibit of apparatus for copying large scale working in the laboratory. The development of chemical processes at high pressures and elevated temperatures had its influence on the apparatus exhibited, whilst the ceramic section, which was a particularly good one, illustrated the progress which has been made in using substances which corrode metals or require high temperatures to react.

As compared with the last exhibition, there was less display of large scale processes requiring a good deal of space and plant for the exhibit, more attention being paid to details. The urge to break away from tradition was sometimes in evidence as, for example, in the vest pocket microscopes.

The spacious gangways made it physically possible to spend some hours at a time at the somewhat arduous task of examination, and the important social side was facilitated by a club room for overseas visitors and other concomitants associated with the Rhine.

Dr. Bretschneider, the organiser of the exhibition, was in evidence on all occasions as a willing and charming helper to all visitors, and all felt how much they owed to his indefatigable energy in organising such a treasure house of chemical weapons. The British visitors found the Rhineland and the Moselle as simple, clean and convivial as ever, whilst travelling was in no way fettered by restrictions of currency or otherwise—they received a real welcome from all. It is well to record that at no time did they see any evidence which would lead them to believe that other than a peaceful reconstruction of Germany is taking place.

Annual Conference of the Association of Teachers in Technical Institutions

AT the recent (twenty-fifth) annual Conference of the Association of Teachers in Technical Institutions, held at Middlesbrough, Mr. H. J. Cull, of the Central Technical College, Birmingham, took over the presidency of the Association from Mr. F. H. Reid, of the Technical Institute, Paddington.

Mr. Cull opened his presidential address with a survey of the results of the application of science to industrial processes, and stressed specially the growth of 'technological unemployment'. "These are the days," he said, "of the second industrial revolution—the coming into full use of electricity and the internal combustion engine. The difficulties are greater than those which marked the passage into full use of steam power, mainly on account of the speed of the development." He instanced the following as illustrations of his point: the rise in production of several nations between 1925 and 1929 was 38 per cent in Poland, 54 per cent in Canada, 30 per cent in France, 22 per cent in Germany, 14 per cent in the United States and 13 per cent in Great Britain. More important, perhaps, was the physical output per worker: in Great Britain in 1924–29 there was an increase of 11 per cent. The figure for the United States rose by 50 per cent in a quarter of a century. In 35 typical American factories the output per man hour between 1919 and 1927 rose 74 per cent. "It is futile," said Mr. Cull, "to think of retarding these scientific applications, and of 'scientific holidays', and so the consequences remain to be faced … it is now apparent that this machine age will demand that, if employment is to be continuous, skill will be judged by adaptability. It is for future consideration to show the precise form of the demands of this changing industrial condition on the technical teacher." Mr. Cull then linked with his general picture of these industrial changes their implications of the work of junior technical schools, juvenile instruction centres, continuation classes, regional co-ordination of technical education, etc., and the need for educational research. He also directed special attention to the course for laboratory assistants promoted by the

Institute of Physics in order to remove from some of these appointments the suggestion of blind alley employment

At the Association's annual dinner, the question of industrial changes and the need for adaptability was deftly sketched by Dr R E Slade (Imperial Chemical Industries, Ltd) who responded to the toast of 'Education and Industry" Since world markets are changing he said, industry must keep pace with the changes On the north east coast, industry has one of the finest positions in a free trade world, but since the free trade world no longer exists, industry is compelled to adjust itself At the Imperial Chemical Industries works at Billingham they set out to send nitrogenous fertilisers all over the world The plant was completed in 1929 But the world now requires only a portion of these fertilisers, and the firm had to turn its attention to other products for home and export purposes The factory is now working hard on other things, and is being extended Dr Slade insisted that changes in industry can be achieved only by full confidence in technical and research staffs Only the association of commercial minds with scientific and technical possibilities will lead to success Workers on Tees side he declared, are wonderfully adaptable, and this is due to technical training

A resolution passed during the Conference urged the necessity of grace periods up to one year in order that technical teachers could undertake research or gain further industrial experience Other resolutions pressed for an extension of part time day classes which would be attended by students during the normal working hours of industry, and for closer co operation between the Board of Education and the Ministry of Labour in connexion with juvenile instruction centres

University and Educational Intelligence

CAMBRIDGE —Dr O M B Bulman, of Sidney Sussex College has been appointed University lecturer in geology M Black, of Trinity College, has been appointed University demonstrator in geology Dr G N Myers of Sidney Sussex College University demonstrator in pharmacology and Dr H A Krebs University demonstrator in biochemistry

An election to the Isaac Newton studentships will be held early in the Michaelmas Term 1934 These studentships are for the furtherance of advanced study and research in astronomy (especially gravitational astronomy) and physical optics Candidates are invited to send in their applications to the Vice Chancellor between October 9 and October 15

LIVERPOOL —Dr Henry Cohen, lecturer in medicine in the University and honorary physician to Liverpool Royal Infirmary, has been appointed to the chair of medicine in the University in succession to Prof John Hay, who retires at the end of the present session

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PROF L M MILNE THOMSON, assistant professor of mathematics at the Royal Naval College, Greenwich, has been appointed professor as from September 30 next

AN International University Conference has been arranged by the Association of University Teachers to be held at Oxford on June 29–July 2 This Conference will be the first attempt to form an organ of direct co-operation between universities of all countries Among the subjects to be discussed at the Conference are university organisation, vocational instruction, interchange of teachers, opportunities for research by foreign students, academic freedom Further information can be obtained from Prof R C McLean, University College, Cardiff

THE first Register of the London School of Economics and Political Science (Houghton Street, Aldwych 3*s* 6*d*) which has just been published contains, in addition to short biographies of former students and a list of lecturers since 1895, an interesting introduction contributed by Sir William Beveridge, the director of the School, describing its growth At first the School did not prepare students specifically for examinations In 1895 there was no teaching University of London, no internal degree, no university professoriate and no faculty of economics There was an examination authority and there were individual colleges such as University, King's or Bedford, but these had no organic relation to each other or to the examining authority The teaching University as it has grown since 1900 out of the London colleges is a new thing altogether Since the War, there has been a rapid growth in the number of regular students of normal university type attending the School, and this has been accompanied by a decline in those listed as occasional The number of regular students is now about 1,300 that of occasional students about 1,100, while the regular teaching staff numbers 89

THE report of the president of Columbia University, New York, Dr Nicholas Murray Butler, for 1933 includes a discussion of some fundamental questions relating to the organisation and development of universities in the United States Dr Butler admits the confusion which results from the lack of an official definition of a university in the United States and of authority for its creation and recognition Nothing is easier than for a college in this country to call itself a university, even though it has not the first characteristic of university organisation, method or ideal" There is no such thing as a private university, he says Some may be supported by taxes and others not, but all are public institutions The American college covers the field which on the Continent is occupied by the upper years of the *lycée* or *gymnasium* and the first year of the university Hence there are but 11 universities in England, 4 in Scotland, 1 in Wales, 5 in Belgium and 8 in Holland, 17 in France and 23 in Germany, 3 in Austria 4 in Hungary 25 in Italy and 11 in Spain But in the United States there are 263 universities, colleges and technological institutions approved by the Association of American Universities Of these, 36 are institutions having a more or less complete university organisation The *World Almanac* lists 579 universities and colleges in the United States The tendency in the United States appears to be to regard the graduate student only as doing 'university' work "The university student", says Dr Butler, has a quite different outlook and a quite different method of approach to his field of intellectual interest " The teaching staff at Columbia in 1932–33 was 3,064 (comparing with 3,255 for the previous session) and 5,609 degrees, certificates and diplomas were granted, the total number of resident students being 30,583, of whom 13,144 were graduate and professional students

Science News a Century Ago

Entomological Society: Prizes for Essays

At a general meeting of the Entomological Society, held on June 2, 1834, the Rev William Kirby, F R S , honorary president, in the chair, a scheme for the establishment of prize essays to be awarded by the Council, on the subject of noxious insects and remedies was adopted, one of the principal objects of the Society being to make its labours practically useful Accordingly, an annual sum of five guineas, or a gold medal of the like value, would be made available for the writer of the best essay (drawn up from personal observation) upon the natural history, economy, and proceedings of such species of insects as are obnoxious to agricultural productions, to be illustrated by figures of the insects in their different states , together with the result of actual experiments made for the prevention of their attacks or the destruction of the insects themselves It was decided that the subject of the essay for the year 1835 should be the turnip fly (Entomol Soc *Journal of Proceedings* 1834)

Public Education in Great Britain

Early in 1834 Parliament had granted £40,000 for assisting the National Society for Educating the Poor and the British and Foreign School Society in erecting schools, this being the first grant of its kind On June 3, 1834, Mr J A Roebuck M P for Bath, moved for the appointment of a select committee to inquire into the means of establishing a system of education Nobody he said, would contest that the legislature considered the moral and intellectual improvement of the people so important as to justify an inquiry, in order to ascertain how far their moral and mental culture could be affected, influenced, or promoted by the Government The motion was seconded by Sir W Molesworth who considered that the education of the lower classes was as deficient in quantity as it was in its quality, and it left the minds of the people in a state of indifference which could not but be condemned by every well thinking individual Lord Morpeth supported the motion, remarking that the grants already made could only be looked upon as experimental, as they were quite inadequate for the purpose of general education After considerable discussion on the suggestion of Lord Althorp Chancellor of the Exchequer, the motion was altered to read that a select committee be appointed to inquire into the state of education of the people of England and Wales and into the application and effect of the grant made last session for the erection of school houses and to consider the expediency of further grants in aid of education"

The Royal Society

On June 5, 1834, ten additional candidates were elected into the fellowship, following nineteen elected previously in April Their names were John, Marquess of Breadalbane, Charles John, Lord Teignmouth, the Hon George Elliot, the Rev Frederick William Hope, Joseph Jekyll, the Rev Robert Murphy, Sir George Rose, Richard Twining, William Robert Whatton, Dr George Witt

Among the newly elected in the above list, only a few can be said to have achieved distinction in science, social and family connexions in the main seeming to serve as claims to recognition The Rev F W Hope, entomologist, is held in universal esteem for his contributions to entomology, and as founder of the chair of zoology in the University of Oxford Hope took an active part in the formation of the Zoological Society in 1826, and of the Entomological Society in 1833 Robert Murphy, mathematician, was one of the seven children of a shoemaker He early evinced mathematical qualities of mind and ultimately graduated at Cambridge as third wrangler William R Whatton, surgeon and antiquary, was not long a fellow He died on December 5, 1835, in his forty sixth year

Steam to India

In the *Mechanics Magazine* of June 7, 1834, it was stated that The House of Commons has on the motion of Mr Chas Grant appointed a select committee to inquire into the best means of promoting steam communication with India The Messrs Seaward of the Canal Works, Millwall in a pamphlet which they have recently published on the subject, recommend that vessels of very large capacity should be employed—of 1,600 tons, for example, with engines of 246 horse power Such a vessel, they say, would allow of 900 tons being appropriated to merchandise, 100 to provisions and water and 460 to coals—which last would suffice with occasional assistance from the wind to carry her to the Cape, where a further supply of coal could be obtained The time occupied on the voyage is calculated not to exceed eleven weeks In 1825, the steam vessel *Enterprise* had made the voyage from Falmouth to Calcutta via the Cape, but she had taken nearly four months for the passage Five years later, the Admiralty started a steam packet service from Falmouth to various Mediterranean ports, and through this came the proposal to send mails by sea to Alexandria, whence they would be taken overland to Suez where a steam vessel would be waiting to convey them to Bombay By an agreement between the British Government and the East India Co , this scheme came into force in 1837, thus reducing the time for letters to reach India by a half

Wellington as Chancellor of the University of Oxford

On Monday, June 9 1834, the Duke of Wellington arrived at Oxford for his installation as Chancellor of the University, alighting at the gate of University College of which the vice chancellor was the master His election had been received with much enthusiasm, and the proceedings of June 10–13 were marked by many brilliant gatherings On Tuesday forenoon, he proceeded to the Theatre accompanied by Lords Londonderry Montague, Apsley and Hill, and on opening the Convocation declared that it had been convened for the purpose of conferring the degree of doctor of civil law on several distinguished individuals including the Dutch Minister, the late Russian Minister, the Dukes of Buccleugh and Newcastle, the Marquises of Salisbury and Bute, the Earls of Warwick and Winchelsea and others Next morning, another gathering took place in the Theatre, of which the galleries, as before, were crowded with undergraduates who cheered the names of Wellington, Nelson, Canning and Pitt and the mention of the House of Lords and the University of Oxford, but showed their disapproval of references to the University of London, the "Gower Street Company" and the admission of Dissenters

Societies and Academies

LONDON

Mineralogical Society, March 15 ARTHUR RUSSELL Baryte crystals from the Manvers Main Colliery, Wath upon Dearne, near Rotherham, Yorkshire A cavity containing exceedingly beautiful colourless crystals of baryte was discovered in the roof of the Parkgate Seam of this colliery in 1930, and the occurrence was briefly described by C P Finn in the same year Two distinct habits of crystals occurred, prismatic and tabular The crystals are attached to cream coloured rhombohedra of dolomite which form a coating on the grey sandstone, both baryte and dolomite being for the most part more or less thickly sprinkled with small bright twinned crystals of chalcopyrite The crystal forms present are listed and drawings of the crystals are given W Q KENNEDY The conditions for the crystallisation of hornblende in igneous rocks By means of a statistical study of the MgO CaO FeO ratios of igneous hornblendes it is shown that the latter occupy an intermediate position between the diopsidic pyroxenes and the magnesia rich, lime poor monoclinic and orthorhombic pyroxenes It is concluded therefore, that (1) pressure and the concentration of the volatile constituents are not the sole determining factors in the crystallisation of pyroxene and hornblende from a magma, but that the original proportions of the constituent oxides play an equally important part, (2) a magma which will produce hornblende as its ferromagnesian constituent under physical conditions tending towards the retention of the volatile constituents will, under effusive conditions, produce diopsidic pyroxene + hypersthene or enstatite augite (pigeonite) ARTHUR RUSSELL An account of British mineral collectors and dealers in the seventeenth, eighteenth and nineteenth centuries (contd) John Williams of Scorrier House, Cornwall, mine agent and adventurer, copper and tin smelter and banker, born September 23, 1753, died April 17, 1841 The collection of Cornish minerals which he had formed at Scorrier in conjunction with his son John (born August 3, 1777, died August 11, 1849) was greatly added to by the latter The collection, which contained about 10 000 specimens, was one of the three finest in Cornwall In 1893 Mr John Charles Williams disposed of the collection by presentation between the British Museum, the Royal Institution of Cornwall, Truro Museum and the Robert Hunt Memorial Museum, Redruth In addition to a memoir of both the Williams, a general account of the collection and its outstanding specimens is given M H HEY (1) On the advantages of the face adjustment for two circle goniometry The statement often made that an accurate projection cannot be so quickly prepared from two circle measurements made with the face adjustment as from measurements made with the zone adjustment is shown to be incorrect, and a construction for the preparation of a projection is described The face adjustment has several decided advantages over the zone adjustment (2) An improved method of crystallographic computations A system for the computation of the elements of a crystal from two circle goniometric measurements is described in which due weight is given to each measured angle in accordance with its estimated probable accuracy (3) On face- and zone symbols referred to hexagonal axes a correction The system of four index hexagonal zone-symbols described by L Weber is correct, and that formerly described by the author is abandoned The derivation of Weber's symbols from a gnomonic or linear projection is described, and their relation to the three index' symbols noted

Physical Society, April 20 LORD RAYLEIGH Further experiments in illustration of the green flash at sunset An artificial source of light and a prism, the dispersion of which is equal to the atmospheric dispersion, was used A straight edge parallel to the base of the prism plays the part of the horizon The observer was 74 metres from the prism On moving the eye into the shadow of the straight edge the bluish green flash was well seen By means of substantially the same arrangement with large dispersion and short distances, the simultaneous contrast effect of a red or orange background was studied, but it was not found possible to obtain a green as opposed to a blue flash in this way With a liquid containing small particles in suitable concentration in front of the source, the disappearing flash is of a brilliant green colour It is concluded that when the flash is bright green, atmospheric filtration is acting to remove the blue light D H FOLLETT An ultra violet photoelectric spectrophotometer The transmission of the sample is found by comparison with a rotating sector of cylindrical type Two photocells are employed and fluctuations in the intensity of the source are compensated for A S RAO and S GOPALAKRISHNAMURTY The spectrum of trebly ionised bromine Vacuum spark and discharge tube spectra of bromine have been investigated over a wide range Many of the triplets and singlets involving the terms due to *4p*, *5s*, *4d*, sp^3 and *5p* configurations have been identified From the present work the classifications made by S C Deb appear to be incorrect The deepest term $4p^3P_0 = 404{,}892$ cm^{-1} yields an ionisation potential of about 50 v for the trebly ionised atom of bromine T C SUTTON and H L HARDEN The purity required for surface tension measurements The extent to which impurities affect the measured value of the surface tension of a liquid depends on the method of measurement employed This effect is applied to test whether the purity of a sample is adequate for the measurement of the surface tension of the pure liquid E E WRIGHT Velocity modulation in television The motion of a spot of light of constant intensity, necessary to produce the effect of a sinusoidal linear distribution of light intensity on a television viewing screen, is determined and the effect of the finite size of the scanning spot is compared with the analogous effect in the more usual type of television system in which the scanning spot moves with constant speed and is modulated in intensity

Society of Public Analysts, May 2 A SHAW Determination of free silica in coal measure rocks Whilst the method of rational analyses for the determination of free silica in coal measure rock tends to give results too low by about 2 per cent, it is far more accurate than calculations from the ultimate analysis, micrometric measurements of shale sections, or X ray analysis S A ASHMORE A new apparatus for determining the temperature of crystallisation of cocoa butter The temperature at which separation of solid fat occurs is a constant for each fat, and an apparatus has been devised whereby this temperature can be determined with rapidity and precision on as little as 2 gm of fat The Tyndall effect has been utilised by projecting a beam of light through a small tube containing the melted fat suitably enclosed in a darkened chamber, as soon as any separation of solid particles occurs, a scattering of light takes place, and the tube appears luminous against the darkened background S A Coase Determination of small quantities of germanium in the presence of arsenic The electrolytic reduction of germanium dioxide to monogermane has been investigated A suitable apparatus is described and it is shown that the yield of gas is greatest when (i) the cathode is of nickel, (ii) the alkalinity of the solution is low, (iii) the current density is high By using the electrolytic March test with a standardised apparatus, 0 027 mgm of germanium dioxide can be detected S Ueno and H Ikuta Saturated fatty acids of chrysalis oil Palmitic acid is the main constituent of Japanese chrysalis oil, stearic acid and a saturated fatty acid of the C_{18} or C_{22} series have also been isolated

PARIS

Academy of Sciences, April 4 (*C R*, 198 1281 1328) Emm de Margerie Notice on William Morris Davis, *Correspondant* for the Section of Geography and Navigation L Lecornu The lighting of roads Mathematical discussion of the most advantageous form for the mirrors of street lamps Emile Cotton Local study of a surface and of certain integrals René Lagrange Congruences of circles which have two focal diameters A Delgleize The transformations of surfaces M Ghermanesco A system of equations with an infinity of unknowns N Lusin Some difficult problems of the theory of functions S P Liau The light curve of the star *G*0 Cygni and the elements of the double system The curve given is based on 200 observations, and from this, together with the spectroscopic data of J A Pearce, the constants for the double star are deduced Pierre Vernotte The calculation of the heat losses of the walls of motors, and more generally, on various non adiabatic phenomena Michel Loève The means of Dirac's theory P L Cassou and J Cayrel Remarks on the true capacity of coils T Nanty and M Valet The specific inductive power of colloidal solutions Emile Sevin The reciprocal action of waves and particles in a constant field L Néel The interpretation of the paramagnetic properties of alloys P Jacquet A method of measuring the adherence of electrolytic deposits A Andant, P Lambert and J Lecomte The application of diffusion spectra (Raman effect) and absorption in the infra red to distinguish between the five isomeric hexanes By the simultaneous use of both methods, the purity of each hydrocarbon and freedom from other isomers can be ascertained Daniel Chalonge and Etienne Vassy The absorption spectrum of oxygen in the extreme ultra violet Gérard Petiau The radioactive series and the classification of the light elements Maman The preparation and some physicochemical properties of hexane and its isomers Full details of the preparation and properties of normal hexane, isohexane, methyldiethylmethane, trimethylethylmethane, diisopropyl Jean Escher Desrivières, Robert Faillie and Raymond Jonnard Psychomotive visual reactions resulting from an intense illumination of the eye

GENEVA

Society of Physics and Natural History, February 1 P Rossier. The relation between the abscissæ of the extremities of spectrograms of *F*0 stars The coefficients of this relation (which is linear) differ notably from those relating to the *A*0 stars This variation is explained, at least qualitatively, by the application of the laws of radiation and those of the spectral sensibility of the plates P Rossier The total width of the three lines H_{γ}, H_{δ} and $H_{\epsilon} + H$ in spectrograms of the *A*0 and *F*0 stars On normally exposed spectrograms, this width is a sensibly linear function of the length of the spectrogram Its variation is more rapid for the *A*0 stars than for the *F*0 stars The use of over exposed spectrograms may lead to mistakes J Weigle and H Saini The thermal expansion of calcite measured with the X rays The authors have determined the coefficients of thermal expansion of calcite measured by means of the X rays They have found for the mean coefficients between 20° C and 100° C the following values $\alpha_{11} = 21 \times 10^{-6}$ $\alpha_{1} = -4 \times 10^{-6}$, values sensibly different from those obtained by Benoit by means of macroscopic measurements, namely, α_{11} 25×10^{-6} α_{1} -5×10^{-6}

ROME

Royal National Academy of the Lincei, November 5 U Cisotti Differential deductions from the definition of reciprocal vectors successive derivations (2) G A Maggi Reflection and refraction of harmonic electromagnetic waves of any form whatever at a plane surface G Armellini Investigations on the form of the nuclei of extra galactic nebulæ, and on cosmic repulsion Q Majorana Metallic photo resistance experiments in a current of water In order to distinguish the new purely photoelectric effect recently examined from any thermal effect occurring, the influence of a stream of water on the metal sheet struck by the light has been investigated From the results obtained the existence, in part at least, of the photoelectric characteristic of the phenomenon of metallic photo resistance is assumed G Levi and Hertha Meyer Mitotic division of nerve cells in cultures *in vitro* A technique is described which renders it possible to observe such division B Manià Mayer's problem In some cases at least, it is possible, from the conditions sufficient for the semi continuity of the integrals and for the existence of the solution in problems relative to the extreme limits, to deduce conditions sufficient for the semi continuity and for the existence of the solution in Mayer's problem Maria Cibrario Properties of the generalised numbers and polynomials of Bernoulli and of Euler P Dienes A theorem of Fermi T Wazewski The unicity and limitation of the integrals of equations to partial derivatives of the first order L Campedelli The algebraic surfaces on which curves of genus π and degree n equal to or greater than $2\pi - 2$ exist B Segre Geometric functional determination of groups of covariant points relative to a net of curves on an algebraic surface A Colacevich The orbit of the visual double 831 A Signorini Finite deformations of systems with reversible transformations G R Levi and D Ghiron Boron arsenate and its mixed crystals with boron phosphate Boron arsenate, which has not previously been prepared, forms tetragonal crystals, $a = 4\ 46$ A, c $a = 1\ 524$ It gives mixed crystals in all proportions with boron phosphate which also forms tetragonal crystals $a = 4$ 33 A c $a = 1$ 532 G AMANTEA Determination of the beriberi quotient Q_b notes on technique V ZAGAMI Further considerations on the food value of seeds of *Cicer arietinum L* These seeds contain proteins sufficient to supply the needs of adult rats over a protracted period but they are deficient in saline matter and also in other factors probably the fat soluble vitamins A and D Vitamins B and E are apparently present in suitable proportions

VIENNA

Academy of Sciences February 15 L PORTHEIM H STEIDL and F KÖCK Orienting investigations on the influence of ultra short waves on flowers Flowers and inflorescences of 47 different plant species were exposed in test tubes in a condenser field to waves of 3 4 metres Very high temperatures were quickly developed in the tubes these reaching 80 90° C in 27 per cent of the total number within 30 seconds Substances contained in the plant cells are evidently capable of transforming the applied energy rapidly into heat F TSCHERMAK Cultivation of a native oil fruit not sufficiently valued Crossing of a pumpkin with huskless seeds with a husked edible pumpkin having no tendrils yields a fruit rich in comestible oil ARNULF KNAFFL Applicability of similarity considerations to the flow of electricity in gases ionised by X and gamma rays

February 22 ERNST BEUTEL and ARTUR KUTZELNIGG Coloured bromine sorbates Bromine vapour is absorbed by a number of substances including various oxides and salts marble and vegetable fibres with development of more or less intense coloration In general substances which readily take up iodine are also good sorbents for bromine although certain striking exceptions occur

Forthcoming Events

Monday June 4

ROYAL GEOGRAPHICAL SOCIETY at 5 30 —Bosworth Goldman Through Afghanistan to India

Tuesday June 5

RESEARCH DEFENCE SOCIETY at 3 —(at the London School of Hygiene and Tropical Medicine Keppel Street W C 1) —Prof J Barcroft Experiments on Man (Stephen Paget Memorial Lecture)

Thursday June 7

CHEMICAL SOCIETY at 3 —(at the Chemical Research Laboratory Department of Scientific and Industrial Research Teddington) —Discussion on Chemical Syntheses under Pressure Speakers R Taylor Dr D V N Hardy and Dr D D Pratt

ROYAL SOCIETY at 4 30 —Prof G I Taylor The Mechanism of Plastic Deformation of Crystals

Prof G I Taylor The Strength of Rock Salt

C A Beevers and H Lipson The Crystal Structure of Copper Sulphate Pentahydrate $CuSO_4$ 5 H_2O

ASSOCIATION OF APPLIED BIOLOGISTS June 8 Annual summer meeting to be held at the Wellcome Physiological Research Laboratories Langley Court Beckenham, Kent

Official Publications Received

GREAT BRITAIN AND IRELAND

Amgueddfa Genedlaethol Cymru National Museum of Wales The Life-History of Birds a Handbook to a Temporary Exhibition November 1933–February 1934 By Colin Matheson Pp 23 (Cardiff National Museum of Wales) 3d

The Liverpool Medical School, 1834–1934 a Brief Record. By Arthur A Gemmell Pp 23+5 plates (Liverpool University Press of Liverpool London Hodder and Stoughton Ltd.) 1s

Department of Scientific and Industrial Research Second Report of the Steel Structures Research Committee Pp xviii+360+25 plates (London H M Stationery Office) 7s 6d net

The Institution of Professional Civil Servants Annual Report of Council for the Year 1933 Pp xiv+72 (London)

The West Riding of Yorkshire Rivers Board Forty first Annual Report Pp 70 (Wakefield)

Ministry of Health Report of Conference between Representatives of the Advisory Committee on Nutrition and Representatives of a Committee appointed by the British Medical Association Pp 7 (London H M Stationery Office) 2d net.

OTHER COUNTRIES

Smithsonian Miscellaneous Collections Vol 89 No 6 The Classification of the Free-living Nematodes and their relation to the Parasitic Nematodes By I N Filipjev (Publication 3216) Pp 63+8 plates (Washington, D C Smithsonian Institution)

Report of the Kodaikanal Observatory for the Year 1933 Pp 3 (Delhi Manager of Publications) 1 anna 1½d

Report of the Aeronautical Research Institute Tôkyô Imperial University No 105 Motion of Flying Boats during Take-off and Landing Run By Taitiro Ogawa and Yosiro Murata Pp 291 334 (Tôkyô Koseikai Publishing House) 35 sen

Proceedings of the California Academy of Sciences, Fourth Series Vol 21, No 14 Formicidæ of the Templeton Crocker Expedition 1933 By Prof William Morton Wheeler Pp 173–181 (San Francisco California Academy of Sciences)

Proceedings of the Academy of Natural Sciences of Philadelphia Vol 86 Zoological Results of the Third De Schauensee Siamese Expedition Part 1 Fishes By Henry W Fowler Pp 67 163 (Philadelphia Academy of Natural Sciences)

Colony of Mauritius Annual Report of the Royal Alfred Observatory for the Year 1932 Pp 9 Miscellaneous Publications of the Royal Alfred Observatory No 14 The Cyclone Season 1931 1932 at Mauritius By N R McCurdy Pp 7+41 plates (Port Louis Government Printer)

Journal of the Indian Institute of Science Vol 16A Part 14 The Solubility of Silver Chloride By P C Dave and K R Krishnaswami Pp 159–165 1 rupee Vol 16A Part 15 Contributions to the Physiology of Sandal (*Santalum album* Linn) Part 1 Nature and Extent of Parasitism, Part 2 Influence of Host on the Nitrogen Metabolism of Sandal By Y V Sreenivasa Rao Pp 167 184 1 rupee Vol 16A Part 16 Indian Coal Tar By S K Ganguly, L Sanjiva Rao and P C Guha Pp 185–192 8 annas Vol 17A, Part 3 The Gas from Indian Oil Wells By G P Kane, K R Krishnaswami and H E Watson Pp 33–40 12 annas Vol 17A Part 4 Reactivity of Dimethyldihydroresorcin Part 3 Azo-dyes and Diazo-oxy Compounds By B H Iyer and G C Chakravarti Pp 41–47 12 annas (Bangalore)

Conseil Permanent International pour l Exploration de la Mer Temperature and Salinity at the Surface of the North Sea and the English Channel By J P Jacobsen Pp 20 (Copenhague Andr Fred Høst et fils) 2 00 kr

Ministry of the Interior Egypt Department of Public Health Research Institute and Endemic Diseases Hospital Second Annual Report, 1932 Pp viii+38+2 plates (Cairo Government Press) 12 P T

U S Department of the Interior Geological Survey Water Supply Paper 737 Surface Water Supply of the United States 1932 Part 12 North Pacific Slope Basins A Pacific Slope Basins in Washington and Upper Columbia River Basin. Pp vi+184 (Washington D C Government Printing Office) 15 cents

Carnegie Institution of Washington Supplementary Publications No 7 Racing Capacity in the Thoroughbred Horse Part 1 The Measure of Racing Capacity, Part 2 The Inheritance of Racing Capacity By Dr Harry H Laughlin Pp 26 (Washington D C Carnegie Institution)

American Psychical Institute Bulletin 1 History of the A P I an Instrumental Test of the Independence of a Spirit Control Pp iii+95 (New York American Psychical Institute) 2 dollars

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CATALOGUES

Australia New Zealand and the Islands of the Pacific (Catalogue N S No 12) Pp 70 Periodica (Catalogue No 13) Pp 12 (London Wm Dawson and Sons Ltd)

Geographie Ethnographie Prähistorik mit einer grossen Anzahl von alten geographischen Werken (Antiquariats Katalog 218) Pp 42 (Leipzig Max Weg)

Livogen (Liver Extract with Vitamin B and Hæmoglobin.) Pp 4 (London The British Drug Houses Ltd)

B T L Monthly Bulletin No 18 May Pp 4 (London Baird and Tatlock (London), Ltd)

Catalogue of Botanical Books from the Library of the late C C Lacaita (Catalogue No 223) Pp 32 (London Dulau and Co Ltd)

Catalogue of Books on all Technical Subjects and Applied Science Pp 110 (London W and G Foyle Ltd)

Object Glasses, Mirrors etc, for Astronomical Instruments (Pamphlet No 106) Pp 8 (Newcastle upon Tyne Sir Howard Grubb Parsons and Co)

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Co operation in Industrial Research

THE stimulating lecture on fundamental scientific problems in the food industry delivered by Dr L M Lampitt before the Liverpool and the Edinburgh Sections of the Society of Chemical Industry early this year directed attention to a number of problems in research which are of interest far beyond the bounds of the food industry Dr Lampitt for example was emphatic on the importance of the co ordination of research not merely of that financed or directed by the State but also of that carried out by academic or private institutions or by industry itself Through lack of such co ordination not merely in the food industry but in other industries as well there is overlapping and waste of effort and also failure to undertake some of the more fundamental work upon which progress finally depends

Dr Lampitt suggested that one of our most urgent problems is to explore the possibilities of effective co operation between the research stations research associations the universities and the industrial research organisations A survey of extra university research in pure and applied science has already been undertaken by the Association of Scientific Workers and should provide much useful data for the study of the possibilities of co operation The existence of duplication and the neglect of fundamental problems constitute powerful and sufficient reasons for an attempt to formulate a definite policy which would enable the greatest use to be made of each type of activity Such a policy in itself would ensure closer contact between the scientific investigator and the industrial world and would tend to eliminate any tendency for the former to work on problems which he considers to be of practical importance but which a representative of industry would easily demonstrate to be of no appreciable utility

The elimination of duplication and waste of effort even with existing resources should tend to liberate funds for fundamental scientific research, the position of which has already been seriously threatened by the restriction of the funds available for the Department of Scientific and Industrial Research As stated in the report for the year 1930–31 in curtailing such expenditure the policy of the Privy Council was to concentrate available funds on work of the most immediate practical value to industry leaving to happier times the expansion of work of which the results could only be available at some more distant date In the campaign which has since been undertaken to secure support for the research association scheme following on the exhaustion of the Million Fund, stress has been laid once more upon the work of the most immediate practical value, and the prosecution and endowment of fundamental and long range research have not received the attention which their place in the national economy demands Apart from this, although the Department has done much to encourage fundamental research in universities and other institutions, it has from the first attempted to induce industries to undertake work for themselves rather than to carry out scientific work for them or even to organise fundamental research

This position while general is fortunately not universal Certain of the research associations, for example have been and still are pursuing investigations of fundamental scientific importance, the application of which has yet to be demonstrated Other sections of industry have made their own arrangements for assisting academic research at the universities by a system of grants in aid of investigations on purely scientific subjects which are likely to contribute indirectly to the solution or understanding of industrial problems

As a prelude to such co operation it is essential that we should think out clearly the place and contribution of each variety of research organisation in relation to the economy of whole industries, and indeed of the national and not merely of individual industrial units or geographical or sectional interests It should not be too difficult a task, given a broad outlook and a spirit of good will and co operation, to elaborate a policy and devise a scheme which, while permitting full autonomy to individual research units should offer immense advantages in efficiency, economy, and the interchange and discussion of ideas and results among research workers It is unlikely indeed that under such conditions it would be necessary to create a fresh research institute or organisation The more efficient utilisation of funds already available, or a comparatively moderate expansion of expenditure within the framework of our existing organisation, should suffice to finance a good deal of fundamental research the prosecution of which is overdue

A further point made by Dr Lampitt relates to the broader distribution of purely scientific data collected in the research organisations of industry Even the smallest industrial research or analytical laboratory frequently acquires important scientific data and it is rare for such physical or chemical knowledge to be of commercial importance to the firm, or for its disclosure to play into the hands of a competitor If without disclosing the purpose of investigations of this type, means could be found of publishing the results a large amount of knowledge locked up in individual units of an industry could be made available, to the advantage not merely of particular industries but also of the industrial and scientific world as a whole It would, in fact, react to advantage and credit of those firms responsible for the work and would undoubtedly assist in the further and more efficient planning of our available resources

The illustrations cited by Dr Lampitt from the food industry were sufficiently suggestive, but they could easily be multiplied in such fields as analytical work chemical engineering and corrosion or in management methods Much machinery for co operative research already exists which might with advantage be used much more extensively in the exchange of information on non competitive matters Even in regard to the abstracting of chemical literature and information services, mistaken conceptions of individualism and independence still delay progress and make it difficult to achieve standards which are possible by co operation alone

These obsolete ideas are being steadily undermined by the work of various organisations, such as that of the British Chemical Manufacturers in regard to industrial safety, or of the British Standards Institution in the standardisation of materials and practice The development of habits of co-operation and encouragement of the exchange of information on common problems quietly fostered in this way should go far to overthrow ideas of trade secrecy which have prevailed too long With this, however, there is still need for a much fuller realisation of the place of research in everyday industrial practice Industries which plead inability to meet a heavier demand for support of their research organisation cannot in fact, expect much credence to be placed in their protestations, unless they can adduce evidence of a spirit of co-operation and of strenuous efforts to utilise to the maximum advantage by co-operation on such lines the organisations within their bounds already devoted to research

The Gas Referees and the Gas Industry

SCIENCE and industry are dependent for much of their progress on the existence and authority of master men to whom the less experienced and less endowed may turn for direction and advice. During periods of stress or emergency their value is readily recognised and their services eagerly sought; in normal times there is a danger that their existence may be forgotten because of their very modesty and the quiet and unobtrusive manner in which they work; but their presence in the background as an ultimate source of effective authority is essential. Those whom the community choose as such counsellors are men of wide experience, of outstanding ability: men whose word is accepted without question. Often they have retired from the routine of daily duty and, unencumbered by masses of detail, they are thus better able to see a problem in its entirety and to set it in the frame of their whole experience.

In the light of these considerations it is particularly regrettable that any community which in the past has been fortunate enough to possess such a source of counsel, should now contemplate its abandonment. The gas industry in Great Britain is a body which, for nearly seventy years, has possessed a source of inspiration and advice in the eminent men who have held the positions of Gas Referees and Chief Gas Examiner. Names such as those of Rucker, Tyndall and Harcourt, Williamson and Rayleigh, as past holders of these positions, coupled with those of the present gas referees—C. V. Boys, W. J. A. Butterfield, and J. S. Haldane—and the present chief gas examiner, Sir Richard Glazebrook, are in themselves evidence of the type of man who has given his services unsparingly in the interests of the gas industry.

The duties of the gas referees are to prescribe the places, times, apparatus and methods by which the gas is to be tested, and to determine if these tests are being carried out; they also decide the methods by which the apparatus employed is to be tested. Gas examiners, who have to make the tests, are appointed by the local authorities. The referees issue a general specification applicable to all undertakings and, where necessary, special specifications for any particular supply company. They also issue full and detailed descriptions of the apparatus to be used, much of which is the invention of Dr. C. V. Boys himself, and of the method of using this. All this is scientific work involving a knowledge of test methods and of the conditions of manufacture of gas.

The gas companies can appeal on certain points, and the chief gas examiner has to hear and decide the appeals. They can appeal against the specification, but we believe that there never has been such an appeal: nevertheless they value this privilege, and object to the Board of Trade, which is to make the specifications, also hearing appeals against them. They can also appeal against any particular test, and though usually the decision is easy, occasionally abstruse scientific questions are involved.

Such, in brief, are the chief duties of the gas referees and the chief gas examiner, and under their direction the routine business of gas testing has been ably conducted; but their services to the gas industry have been greater than any which could be prescribed by an Act of Parliament. Their real value and their real function have been those of counsellors. In the Gas Undertakings Bill which was recently introduced to the House of Commons, the proposal is made that the offices of Chief Gas Examiner and of Gas Referees should be discharged by the Board of Trade. There can be no doubt that the routine of gas testing, the collection of data relating to the gas industry, and similar routine work, can be efficiently and competently carried out by the civil servants to whom these duties may be delegated by the Board of Trade; but it is impossible that such civil servants, however efficient, can achieve that which has arisen from the eminence of the men who have previously been responsible for this work. The loss which the gas industry would incur by this change is beyond all computation.

It may be suggested, on behalf of the proposed change, that the replacement of the present holders of the offices would be no easy matter. Undoubtedly this is true, for eminent men are always scarce, but amongst present occupants of chairs of physics and chemistry at the universities of Great Britain there are men of outstanding merit who will, by the passage of years, be compelled to retire from active participation in academic work, and would be willing to place at the disposal of the gas industry the knowledge arising from their experience.

It seems incredible that the gas industry in Great Britain should wish deliberately to divorce itself from association with some of the ablest scientific men of the day. Must it not be that the change has been proposed without full consideration of the inevitable consequences?

Atomic Theory

The Atom By Dr John Tutin Pp 109 (London, New York and Toronto Longmans, Green and Co, Ltd, 1934) 6s net

ON the jacket of this interesting book appears the appetising paragraph 'No one interested in modern science should fail to read this book It deals with a problem of profound importance, and although written by a scientist for scientists the clarity and simplicity of the argument are such that the general reader fond of science will find it attractive as well as intelligible" On second thoughts this may not mean very much Science is a big subject and it is by no means certain that any scientific worker, writing on a scientific subject outside his own field deserves to be taken any more seriously than the layman I should not personally consider myself entitled to be regarded as a scientist writing for scientists" if I wrote a book on, say, biochemistry or mechanical engineering But such a claim is made for Dr Tutin, and being made, it is only fair to take it seriously On thinking over past and conceivable future indiscretions of this nature that I have committed or might conceivably commit, I am clear that the great danger for the professional, venturing into another branch of the profession, must always lie in the lack of an adequate background He may well provide exciting new ideas which may prove fruitful or unfruitful, but his critical discussion of current ideas is almost certain to be cruelly handicapped by lack of knowledge of what current theory can or cannot account for in its stride, and of what are the honest to goodness copper bottomed facts

We shall see that it is just here that Dr Tutin's speculation fails If he had known the facts and the present position of current theory, it is scarcely conceivable that he would have put his own alternative theory forward There is, moreover, another danger which, from internal evidence, Dr Tutin does not appear to have avoided—that of forming one's general opinion about the meaning of a theory almost entirely from popular and semi popular expositions without any study of more profound or more original sources Even when the popular expositors are such masters as Jeans or Eddington, this is highly dangerous The fare they provide cannot constitute a well balanced diet for a scientist It lacks the vitamins essential to growth

The thesis put forward by Dr Tutin in this book may be described in outline as follows, the description for distinction is printed in italics

(i) *The Rutherford Bohr model of the atom (for short the R B atom) was first put forward to explain the large angle scattering of α particles, which it did successfully on the assumption that the scattering is due to a small heavy nucleus carrying the charge + Ze where Z is the atomic number and e the (numerical) charge on the electron The same scattering law would be found if the nuclear charge were − Ze*

(ii) *There are grave deficiencies in the general theory based on the R B atom, partly philosophical (the failure of a strict law of causation) and partly practical Its obvious practical deficiencies are its failure to explain 'why some atoms emit light and others do not why some are electrical conductors and others insulators, why some are magnetic and others non-magnetic" (p 15) It fails also to explain chemical valency and chemical combination generally*

(iii) *Accepting the mathematical interpretations supplied by wave mechanics as to the fundamental nature and behaviour of protons and electrons (this is Dr Tutin's own phrase p 13) a much more complicated and satisfactory alternative atomic model can be put forward (for short the A atom) in which the nucleus is a collection of Z electrons and the outer atom contains all the protons and the other electrons (mainly grouped in subordinate structures of mass less than or equal to four) required to produce a neutral structure of the correct mass*

This is the foundation of the book in which Dr Tutin first attempts to specify these and other deficiencies in the current theory using the *R B* atom, and then to show how the *A* atom provides natural and simple explanations of these fundamental properties where the *R B* atom fails, and provides them, moreover, *without any infringements of a strict law of causation*

In his dislike of the law of causation Dr Tutin hates in good company It is a matter of taste about which no argument is necessary But Dr Tutin is wrong in attributing the failure of the law of causation in current theory to a weakness of the *R-B* atom This failure has nothing whatever to do with any special model, but is an inherent property of that very quantum mechanics the results of which Dr Tutin adopts to develop his *A* atom Here it seems he has been misled by his study of some popular exposition The failure of causation is, moreover, a far more refined concept than Dr Tutin appears to believe, and enters quantum mechanics (as the uncertainty principle) only because quantum mechanics, unlike Newtonian mechanics, does not permit of absolutely precise initial conditions ever being laid down in any problem To the degree of precision permitted by the initial conditions the state of affairs at any later time follows as rigorously and uniquely as ever it did in Newton's day To the objection that if quantum mechanics imposes this restraint it is to that extent a bad mechanics the answer is, of course, that only by imposing this restraint can quantum mechanics account for the *diffraction* of electrons by a regular lattice and that, in spite of the unexpected nature of the restraint, quantum mechanics can still in principle predict the results of any conceivable experiment The phenomenon of electron diffraction, which is independent of any particular atomic model, is not discussed by Dr Tutin, presumably for this very reason that diffraction will appear just the same whether the actual atoms are *R B* atoms or *A* atoms This is true enough But the phenomenon disposes of any claim that his theory is either more or less causal than current theory, and the whole of his remarks about the law of causation seem to me to be beside the point

Let us now return to the main thesis that the *R B* atom, plus quantum mechanics is a failure in the regions of physics and chemistry already mentioned and that the *A* atom succeeds at least qualitatively everywhere, without surrendering but rather incorporating whatever successes the *R B* atom has had

If quantum mechanics with the *R B* atom had done no more than Dr Tutin thinks it has done it would certainly be highly vulnerable to his or any other attack But this is far from the truth To take first the question of electrical conductivity —that is, of forming a metal or an insulator in the solid state It has been shown in detail just what conditions must be satisfied for the solid state to be a metal, and in particular it can be rigorously deduced from the *R-B* atom and quantum mechanics that the alkalis must be metals and not insulators The proof can probably be extended to the noble metals Owing to the complexity of the problem it has not yet been rigorously proved that, for example, diamond is an insulator This is to be regretted, of course, but in a qualitative way the solution is already complete enough It is merely the numerical computations which cannot be carried through The qualitative solution extends also to include the queer substances now called semi conductors the conductivity of which increases sharply with temperature Boron, if its properties are correctly described by Dr Tutin, is such a substance, but the classical example is cuprite

To turn to magnetic properties it is again hard to see that qualitatively the current theory fails in any way Qualitatively and even quantitatively, the paramagnetic properties of the rare earth salts are completely accounted for The ferromagnetic properties of the iron group are already accounted for in the sense that using only quantum mechanics and the *R-B* atom, and without any *ad hoc* hypothesis, it can be shown definitely that ferromagnetism will occur when certain possible conditions are satisfied, and in a general way that these conditions might be most easily fulfilled among the metals and alloys of the iron group It is not, however, yet possible to say quantitatively that such a metal or alloy will be ferromagnetic and such another one not[*]

In the optical and X ray field the success of the *R B* atom is of older date, and is not called in question by Dr Tutin except that he maintains that an explanation is required why some atoms, particularly oxygen and sulphur, have a spectrum difficult or impossible (*sic*) to excite I do not think that there is any difficulty here which calls for an explanation so ruthless as Dr Tutin's, whose *A* atoms for oxygen and sulphur contain no free' electron In fact, Dr Tutin explains too much, for he forgets that conditions of excitation are all important When left to itself, even the stubborn oxygen atom emits light, so much so that no spectrogram of the light of the clear night sky can be taken without showing the oxygen atom s auroral green line, while the lines of oxygen and sulphur in several states of ionisation are familiar features of the spectra of the hotter stars

Finally, in the chemical field the qualitative successes of quantum mechanics and the *R-B* atom seem even more striking, and the promise of more quantitative success is rapidly being fulfilled Current theory preserves and explains naturally the fundamental differences between covalent and electrovalent bonds, and accounts also perfectly satisfactorily for the number of possible covalencies—why a covalent link saturates in fact and cannot take part strongly in any further union Complicated as the calculations are, the theory can even account in a general way for the stereochemistry of carbon and why it is unique Two quantum mechanical *R-B* atoms of suitable valency have, in short, in current theory the means to unite and the urge to do so, Dr Tutin's statements to the contrary notwithstanding, the means to unite being an unpaired electron on each and the urge that by uniting with the formation of a new electron pair they can form a state of lower energy

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[*] In all this field of the atomic theory of solids an excellent account of the existing state of current theory will be found in the article by Sommerfeld and Bethe in the Handbuch der Physik', Vol. 24, Pt. 2 (Second Edition)

To sum up this survey of fields touched on by Dr Tutin, bearing in mind evidence from other fields, such as collision theory, on which he does not touch, it seems fair to say that quantum mechanics working on the basis of the *R B* atom promises to be completely competent to embrace in one simple theory the whole range of ordinary physics and chemistry The whole general structure of the periodic table of the elements is explained in this way without any further hypothesis There is no mystery about the periods $2n^2$ They are necessary logical consequences of the theory, which among other things allows only one electron to occupy any one state of given quantum numbers Phenomena which with the *R B* atom are classed as nuclear physics are at present excluded from this range When we come to nuclear properties, though much success has already been achieved by the application of quantum mechanics to the heavy particles in the nucleus, the prospect is not so clear, and great modifications may be necessary before much further progress is made It is well to emphasise finally with what beautiful economy of assumptions all this success can be achieved We require nothing but quantum mechanics applied to electrons and heavy nuclei of charges 1–92, interacting with their ordinary Coulomb forces, nothing less and nothing more (except perhaps patience !)

What has Dr Tutin to offer us in place of this elegant and well co-ordinated theory in which the diverse properties of, for example, C, N and O seem to find a natural place and to be referable, surprising as it may seem to the slight change of one more electron and one more nuclear charge from one atom to the next ? If it were as yet only one tenth as successful, his theory would be worthy of the most elaborate exploration The *A* atom has a light nucleus with charge $-Ze$ with the protonic masses at various distances in orbital motion round it, but so *rigidly* (*sic*) bound to it that the nucleus reacts like a body of atomic mass to any passing α particle This rigid binding is referred to a quantum mechanical restraint Since Dr Tutin's quantum mechanics is our ordinary quantum mechanics we can inquire more closely into this, which he has omitted to do Extra rigidity of this type is found, for example, when electrons bombard atoms, but only when the energy of the bombarding particle is less than the energy of binding Dr Tutin must, therefore, assume new binding forces other than Coulombian to tie the protonic complexes to the nucleus so that their energy of binding may be of the order of 10^7 electron volts at least Non Coulombian forces are also required to enable quantised orbits of heavy particles to be of atomic and not nuclear dimensions (10^{-8} cm rather than 10^{-12}) This is a grave inelegance in his theory, but let us allow these forces and proceed to inquire how such a structure, allowed to be rigid, will scatter α particles

When an α particle passes near the nucleus it will be scattered by the usual Rutherford scattering law with a factor Z^2 for the nuclear charge Ze Note that the extra forces are now ignored and the scattering purely Coulombian ! When it passes near one of the protonic complexes it will also be scattered by Rutherford's law with a factor P^2 when the charge on the complex is Pe This extra scattering has been overlooked by Dr Tutin It does not occur for the *R B* atom because the electrons are light and not rigidly bound to the nucleus, so that they take no part in the large angle scattering This extra scattering must be added on for each protonic complex The resultant scattering will be given by Rutherford's law with the factor $Z^2 + \Sigma P^2$ instead of Z^2 Dr Tutin's model gives a factor sufficiently greater than Z^2 to destroy the agreement between theory and experiment for the scattering of α particles by elements of medium atomic weight The alternative atom fails outright, self strangled at birth

If this point is ceded on the ground that experiments have not established for certain this rather fine distinction, we fall at once into all sorts of terrible difficulties with isotopes For example, lithium consists of two isotopes, Li^6 and Li^7, of which, according to Dr Tutin, the latter contains one free electron and is therefore a metal and the former none and is therefore presumably an insulator, though Dr Tutin does not say so explicitly (A slight conductivity in silicon is attributed to the possession of a free electron by its second isotope, p 57 !) Since deposits of Li^6 and Li^7 can now be obtained separately, it might be interesting to Dr Tutin if experiments were made to determine their separate conductivities, though I doubt if any other chemist or physicist would expect any significant difference between them To chemists in particular, differences so striking between the isotopes of a single chemical element are quite unbelievable, and their disbelief is amply warranted by all the available evidence Since isotopic differences in general are referred by Dr Tutin to the outer rather than the inner structure of the atom—definitely so for light elements—the chemical resemblances of isotopes can only be maintained by unnatural *ad hoc* hypotheses Finally, of course, his theory requires us to refer radioactive properties to the outside rather than the inside of the atom

It would be ungracious to pursue further Dr Tutin's attempt to substantiate the *A* atom He is continually involved in *ad hoc* arguments, which he rightly deplores when he thinks others have used them, as in the explanation with the *R B* atom of the periodic table (p 30) There is in fact nothing *ad hoc* in this His attempted explanation of Moseley's diagram of characteristic X ray lines seems to me shaky in the extreme and looks perilously like invoking a denial of the conservation of energy But this may be doing him an injustice At no point is there any indication that quantum mechanics applied to the models he proposes with some specified law of force between the various parts would give the results he postulates No such law of force, which cannot be Coulombian, is ever specified All his results are just pious hopes and no more, and most of them are demonstrably wrong

Why then review at such length what is here stated to be in the reviewer's opinion entirely without substance ? There seem to be reasons of some cogency In the first place the appearance of an essay such as Dr Tutin's forms a natural occasion on which to overhaul the present position of current theory and do some stocktaking in public Again no physicist who has worked as such during the last twenty five, or even the last fifteen, years should be surprised by any extravagance in the development of physical theory or be unprepared to accept changes even more revolutionary still Nothing could have exceeded the apparently wild extravagance of de Broglie's first work on electron waves which led directly to quantum mechanics Experiments in thought such as that of Dr Tutin must be made and made welcome just because they are experiments, and must not be condemned out of hand But just because the current theory of the outer atom is a successful and flourishing theory, much must be required of any rival that could supplant it, and Dr Tutin's theory cannot stand the pace It must be discarded after examination, not because it is counter to current opinions, but because it is not internally self consistent and does not correlate with sufficient elegance a wide enough range of physical and chemical facts There is also one further reason remaining Dr Tutin's theory has been rather widely noticed in the non scientific Press, where it has sometimes been discussed as if it were an accepted theory—a revolutionary overturning of current views—but alas it is far less momentous Physical theory has undergone such striking and successful revolutionising in recent years that such Press notices can perhaps scarcely be avoided It is all the more necessary that, when a would be revolution, widely heralded, fails utterly, its masquerade as a success should be reduced to the shortest possible limits

R H FOWLER

The Mitten Crab in Europe

Zoologischer Anzeiger Herausgegeben von Berthold Klatt Zugleich Organ der Deutschen Zoologischen Gesellschaft Ergänzungsband zu Band 104 *Die chinesische Wollhandkrabbe* (Eriocheir sinensis *H Milne-Edwards*) *in Deutschland* Von Dr Nicolaus Peters und Dr Albert Panning Mit einem Beitrag von Prof Dr W Schnakenbeck Pp viii + 180 (Leipzig Akademische Verlagsgesellschaft m b H , 1933) 11 60 gold marks

THE invasion of European inland waters by a Chinese river crab which has been in progress for more than twenty years has hitherto attracted little notice from zoologists in Great Britain There is, however a distinct possibility that the invasion may spread to our rivers and that this undesirable alien may establish itself as a member of the British fauna It is therefore desirable that attention should be directed to the exhaustive monograph which has just been published by Dr N Peters and Dr Albert Panning with an appendix by Dr W Schnakenbeck The species is now being used as an easily obtainable type' and as a subject for experimental work in many German laboratories The full and clear account of its morphology and development which is given in this monograph will therefore be very useful In addition, the history of its appearance and spreading in Europe is recorded in detail with full particulars of the damage it causes and with suggestions for its utilisation as food for man and domestic animals.

Eriocheir sinensis is known in Germany as the *Wollhandkrabbe* from the fact that the pincer claws are clothed with long soft hairs, and a writer in the *Times* has suggested 'mitten crab' as an appropriate name for it. It belongs to the family Grapsidæ and, like many of its allies, it is characteristically an inhabitant of brackish water, ascending rivers for long distances in fresh water but returning to the estuaries to breed.

The mitten crab must have been introduced into German rivers before 1912, for in that year a specimen was found by a fisherman in the River Aller, a tributary of the Weser. The specimen was fortunately preserved, although it was not identified until many years later. In 1923 the species was found to be established in the lower reaches of the Elbe and was determined as *Eriocheir sinensis*. Since that time it has become progressively more abundant in the Elbe and the Weser, and it is now caught by the hundredweight at certain seasons in the nets of the fishermen. It has penetrated inland as far as Berlin and even Prague, and has extended its range to the Rhine and the rivers of Holland on one side and to East Prussia on the other. In some localities it has become a very serious menace to the fresh water fisheries, stealing the bait from the hooks and cutting and ruining the nets. It is also stated to damage the muddy banks of rivers by burrowing in them.

The means by which the mitten crab found its way to Europe remain something of a mystery. Dr Peters discusses various possibilities and comes to the conclusion that it was most probably carried in the water ballast tanks of some vessel trading with the Far East. If so, there is no reason to suppose that such an incident might not happen again or that the mitten crab would find in the Thames a less favourable environment than in the Elbe and the Weser. Further, since the adult crabs seem to be equally at home in sea and in fresh water, it will be surprising if they do not succeed sooner or later in crossing the North Sea.

In view of the attempts that are being made to popularise in Germany the use of the mitten crab for human food and for feeding pigs and poultry, Dr Panning directs attention to the fact that in the Far East the species is known to be one of the intermediate hosts of the lung fluke, *Paragonimus*. He points out, however, that owing to the absence from Europe of the species of water snails which are the first hosts of the worm in question, its spread in Europe is most unlikely, and since the crab would only be consumed in the cooked condition, no danger from it is to be apprehended.

The accidental introduction and spread of animals and plants in countries where they are not native is unfortunately common enough, but there are not many instances of aquatic animals being transported unintentionally from one country to another. The case of the mitten crab is therefore of some theoretical, as well as practical, interest.

W. T. C.

Short Reviews

Pharmaceutical Formulas. Vol. 2. *Being the Chemist's Recipe Book of Formulas for Adhesives, Beverages, Cleaning Materials, Culinary and Household Requisites, Horticultural and Agricultural Preparations, Inks, Lozenges, Perfumes, Photographic Preparations, Polishes, Soaps, Toilet Articles, Varnishes, Veterinary Preparations, etc., including numerous Descriptions of Practical Methods employed in their Manufacture and other Information of use to Pharmacists and Manufacturers*. Tenth edition, entirely revised and rewritten by G. P. Forrester. Pp. xx+983. (London: The *Chemist and Druggist*, 1934.) 15s.

"PHARMACEUTICAL FORMULAS", which appeared as a first edition in 1898, is a collection of formulæ of both old and new preparations of interest not only to pharmacists, but also to other manufacturers of articles and preparations of allied types. With the increasing scope of the book, it has been deemed necessary to publish the tenth edition in two volumes, vol. 1 being essentially pharmaceutical and medicinal, whilst vol. 2, now under review, has collected those formulæ of more general and varied interest, such as cosmetics, perfumes, polishes and horticultural and agricultural preparations such as fungicides and insecticides. These sections are but a few of the many varied ones, but they probably constitute those in which the greatest advances have been made in recent years.

The last two decades have seen an enormous increase in the demand for toilet preparations, such as face powders, creams, lipsticks, etc., each with so many varieties that their preparation now requires considerable skill and knowledge. Moreover, fashion would appear to maintain them in popularity, and with ever-varying design and purpose, so that the manufacturers must of necessity keep pace and satisfy the demand. The advent of the cellulose finished motor car body has led to the demand for hard high gloss polishes with a quick effect, which demand has resulted in a large number of new types of formulæ

The proof however, of the value of a book of formulæ lies not only in the ingredients but also in the description of the exact working conditions and correct manipulation without which most technical formulæ are useless The book does appear to satisfy this requirement, and moreover each section is preceded with a monograph discussing the development and modern requirements of the preparations concerned H B

A Bibliography of Sir James George Frazer, O M Compiled by Theodore Besterman, with Portraits and Facsimiles and a Note by Sir J G Frazer Pp xxi+100+3 plates (London Macmillan and Co, Ltd, 1934) 12*s* 6*d* net

THIS bibliography of the works of Sir James Frazer has been produced by the subscription of friends and admirers and under the ægis of the Folklore Society in celebration of his eightieth birthday in January last The work of Sir James Frazer is too well known for this list of his books essays, lectures and addresses to call for extended comment It chronicles a remarkable achievement It may, perhaps come as a surprise to those who are not intimately acquainted with the extent and variety of his writings to find that although The Golden Bough" bulks large, it by no means expresses the whole of his interests nor notwithstanding its many editions, has it absorbed one tithe of the apparently boundless store of energy upon which he has drawn in the fifty five years of his life as an author The Golden Bough is extensive enough to have been the life work of any ordinary individual—assuming that he had the genius to conceive it Yet Sir James in his Totemism and Exogamy", his 'Folklore of the Bible" and his study of immortality has produced three major works, any one of which would have taxed the industry and made the reputation of a research worker

The bibliography has been admirably produced and is illustrated with excellent portraits of Sir James and with facsimiles which show his method of working The first page of the list is marred by a misprint, the editor having fallen into the familiar schoolboy trap of 'Cataline"

The Woodlands and Marshlands of England By H A Wilcox (Mrs G S Treleaven) Pp 55+2 maps (Liverpool University Press of Liverpool, London Hodder and Stoughton, Ltd, 1933) 6*s* net

THE University Press of Liverpool has recently published two maps of the woodlands and marsh lands of England prepared on the researches of H A Wilcox These are founded on several years of research which was assisted by the British Association The first map is founded on geological, climatic and topographical evidence, and the second is drawn from the evidence deduced from early literature To these have been added a discussion of the problems involved and of some of the regional questions The first map involved considerations of the underlying rocks and their soil covering, of the surface configuration of relief, height and aspect, and of the climatic conditions, which as yet are not sufficiently determined even in the immediate past But all three of these act together or in opposition, to provide the area which was woodland covered or heath or bare grassland Then again, woodlands may destroy themselves by the accumulation of their decaying materials and by holding up water, changing lands into marshes Many areas can be only tentatively mapped, awaiting the local research of counties The corrections made thereby are essential to this study, and it is requested that they be communicated to Prof Roxby of the University of Liverpool The subject is an important one, for it is basal to the study of early man in Britain, determining his track ways and early settlements

Grundriss der physikalischen Chemie Von Prof Arnold Eucken Vierte Auflage Pp xxiii+699 (Leipzig Akademische Verlagsgesellschaft m b H 1933) 29 gold marks

THE third edition of Eucken's Grundriss der physikalischen Chemie' was merged in a Lehrbuch of 1,000 pages, issued in 1930 (NATURE, Dec 27 1930, p 988) but even then the project existed of splitting the product into two parts, the more general and elementary part being issued as a fourth edition of the Grundriss" and the more special and advanced part as a second edition of the 'Lehrbuch" The first portion of this project has now been carried out, and has yielded a volume of 700 pages with 179 instead of 250 figures The tables and figures have been taken for the most part from the 'Lehrbuch", but the text has been condensed by omitting much descriptive matter (for example, Aston's mass spectrograph) and concentrating on fundamental laws Numerical exercises have also been added at the ends of certain chapters

Science and God By Bernhard Bavink Translated by H Stafford Hatfield Pp ix+174 (London G Bell and Sons, Ltd 1933) 5*s* net

IN recent years, fundamental changes have taken place in all the assumptions upon which philosophical and religious discussions are based The author makes the point that mechanistic physics by no means implies atheism and materialism as a necessary consequence, and that the so-called neutrality of science with regard to religious questions is no more an axiom of procedure In fact, the old materialistic arguments, still put forward in free thinking circles will be found to be out of date doctrines in the light of a correct interpretation of the results of present day science T G

Germination of Seeds*

By SIR ARTHUR W. HILL, K.C.M.G., F.R.S.

THE ovule, which later becomes the seed, is enclosed in the fruit vessel or ovary, the covering provided by the mother plant. During its development, the offspring is protected and nourished by its mother, and the ovule gradually develops into the seed, with its own protective skins or coats, lying within the enlarged ovary, which in the course of time has become the fruit.

Examples of fruits with their contained seeds are such familiar objects as the fleshy fruited tomato with its dry, flat seeds, the broad bean or the scarlet runner with the enclosed seeds or beans, and the Brazil nut where the mother plant has provided a thick, woody, cannon ball like protective fruit—which can only be broken by a powerful hammer or cut across with a saw—enclosing the well known hard shelled 'nuts'.

Many seeds have been so well protected by the mother plant that the liberation of the seeds contained in the fruit is often a matter of some difficulty. The Brazil nut fruit is perhaps the most remarkable example. In other cases, however, the seeds are shed or scattered from the fruits with the greatest ease when the fruit is ripe, as any gardener knows only too well who attempts to save seed of an *Impatiens* (balsam) or collect the seeds of gorse, which are shot out from the fruit as if from a catapult. The horticulturist, of course, is concerned only with the seeds when he wishes to replenish his stock of plants. In the majority of cases he merely sows the seed, and germination, that is, the escape of the embryo from the protective seed coats, takes place sometimes in a few days, sometimes after some weeks from sowing. In the case of willows and poplars the seed will germinate the day after it is sown, and if the minute seed should be kept for more than a few days it will completely lose its power of germination. In other cases seeds may remain viable for years. I remember well the late Sir Michael Foster showing me a pot of *Iris*, in which the seed was just beginning to germinate fourteen years after it had been sown! Then there are the seeds of the Australian wattles (acacias) which rarely germinate until a fire has passed over the ground in which they are lying, or which, if sown at home, have to be scraped with a file, or treated with strong sulphuric acid, as is also the case with some other seeds, in order to induce germination, so strong and resistant is the seed coat. It is known that seeds of *Acacia lophantha* will germinate after being stored for sixty-eight years and recently, in connexion with inquiries as to seed vitality, we have experimented at Kew with seeds long stored in bottles in our Museum and have successfully germinated seeds of *Anthyllis vulneraria* and *Trifolium striatum* both ninety years old, and seeds of four other leguminous plants, including the Spanish broom (*Cytisus scoparius*), all eighty one years old.

How long the poppy seed, which germinated and flowered so wonderfully after the shelling of the Somme battlefield, had lain buried in the soil, or how long charlock seed will remain living when buried, we do not really know; but it is truly remarkable that life can persist for so long a time in a body so minute as the embryo of a seed imprisoned within its seed coats, when the seed is preserved under suitable conditions. What the nature of such life may be, and to what extent respiration and the other functions we associate with living matter, may be carried on in dormant seeds, is scarcely within the scope of my text, nor could I throw much light on this arresting problem. For the moment we are concerned with the embryo prisoner, whether serving only a brief or a long sentence of confinement, and the nature of the prison.

There is a minute orifice in the seed, the micropyle, originally the point of entry of the pollen tube into the ovule, behind which ultimately the radicle or root tip of the embryo will lie in the mature seed. Through this minute and well-sealed pore, and also by absorption through the coats, moisture enters the seed when conditions become favourable for germination, and the radicle emerges at the micropyle. In the case of most seeds it is safe and usually advisable to store them through the winter and sow them in the spring, since the embryo is in the resting or dormant condition, whatever that may signify. There are, however, a few seeds which do not undergo any resting stage, but development is continuous, and the embryo is in an advanced stage of germination when the seed is shed. The prisoner effects his escape, as an Irishman might say, before he has been shut up! Willow seeds, as I have mentioned, almost come within this class, but the mangrove, with its viviparous seeds, is a classic illustration. Here the seed in the inverted pear-like fruit germinates while the fruit hangs on the trees. The long fusiform radicle grows downwards and eventually the young plant falls off into the water where it floats upright and gets carried to a safe landing in the mud of a tropical estuary. *Typhonodorum*, a giant aroid from Madagascar, behaves in a similar manner, and well-developed young plants, still attached to the large, bean-like seeds, are shed into the water where they float upright with the young leaves in the air.

In these cases, we might say that the embryo, realising how flimsy and insecure are its prison walls, considers it wiser to escape at once and so avoid the risk of being killed by insufficient protection, which might have happened should it have 'gone to sleep' for a period, like other embryos, after the maternal influences had ceased

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* From the Friday evening discourse entitled 'The Escape of the Prisoner: Studies in the Germination of Seeds' given at the Royal Institution on November 3, 1933. A fuller account of the devices here described with illustrations will be found in *Annals of Botany*, 47, 873, Oct. 1933.

The normal seed consists of two close fitting coats, the inner usually membranous, the outer being either papery, leathery or woody, and often ornamented with most beautiful surface markings which cover and protect the embryo The embryo may be embedded in food material on which it can draw when germination commences—the type known as albuminous—or it may have absorbed into itself, during its development, all the nutritive materials supplied by the mother plant and stored them for future use in its seed leaves or cotyledons —which is known as the exalbuminous seed In either case germination, with the majority of seeds is simple and straightforward the emergence of the radicle, the splitting open of the seed coats and the withdrawal of the cotyledons or seed leaves follows in due course In a few cases, of which the vegetable marrow (*Cucurbita*) is a good example, the young seedling takes special care to free itself from its seed coat and develops a special peg like outgrowth at the apex of its young root which presses on the lower valve of the seed coat while the arch of the young stem carrying the cotyledons lifts up the upper valve and so effects its escape The youthful prisoner thus puts its foot on the floor of its prison house and raises the roof with its bent shoulders

The palms show certain peculiarities in the germination of their seeds, which are unlike those of other plants I will take the familiar date stone (*Phœnix*) as my example Dates are fleshy fruits with a hard horny like stone in the centre, which is the seed In the middle of one side of the seed there is a small circular umbilicus or navel behind which lies the embryo Owing to the horny nature of the endosperm of the seed, it would be well nigh impossible for the embryo to escape if the date attempted to germinate in the usual way since the cotyledon and shoot apex could not get free from the seed, even though the root could grow out and push down into the ground The problem is solved by the date, coco nut, double coco nut and other palms by transporting bodily the whole embryo out of the seed through the navel-like depression and burying it in the ground some distance below the surface of the soil This is accomplished by the outgrowth of a closed germ-tube, the cotyledonary sheath, completely surrounding the embryo, which in the double coco nut is a stout formidable looking article Though the embryo has been taken out of the seed however, and is being nourished by the supplies contained in the seed through the cotyledonary sheath or tube, the problem of its escape is not yet solved, since it is still a prisoner within its own tube like sheath It is as if the walls of its prison cell had become elastic and extensible and the cell had extruded itself through its window, carrying the embryo still imprisoned within the elongated cell, a procedure which may be compared to a person sliding down a tubular fire escape from a window

The embryo, however, is able to solve the problem for the young shoot with its seed leaf grows and forces its way through the wall of the germ tube and emerging into the air finally starts on an independent existence This may take place in a fairly short time, but in the case of the double coco nut several months elapse after the embryo is carried out of the seed before the young palm leaf of the seedling escapes into the daylight The coco nut and double coco nut differ a little from the date in that the actual seed is enclosed in the innermost wall or endocarp of the fruit, and are thus similar to cases I am about to describe, otherwise the procedure is exactly like that exhibited by the date

Turning now to those seeds which have an additional protection in the way of part of the fruit wall as well as their normal seed coats as in the coco nut to which I have just referred I may mention first the more simple cases of plums, cherries almonds and olives In these cases the edible flesh is part of the 'fruit' proper but the stone is also a portion of the fruit wall, so that it is not strictly correct—botanically—to speak of plum or peach stones or coco nuts as 'seeds', since the stone is a fruit structure and only the kernel is the actual seed

The fruit wall or pericarp consists of three layers or coverings the outer one which is the skin the middle fleshy and edible portion the mesocarp, and the hard innermost layer, the stone or endocarp which encloses the seed or seeds Stones or stony endocarps of this nature may contain one, two or several seeds

Cherry or plum stones afford good examples of stony endocarps containing a single seed, and the embryo has not only to solve the problem of escaping from its seed coats, but also the more difficult task of getting out of the woody box like stone, which has to be cracked by hand should one wish to obtain the kernel

Careful examination of a plum stone shows the endocarp to consist of two similar and closely united halves only separable when the plane of weakness becomes softened The cells of the stone do not cross the line of junction of the two halves of the stone, but are turned at right angles at the median line and the two distinct halves are firmly 'cemented' together The stone thus easily splits into its two halves, after sufficient moistening by the pressure exerted by the emerging radicle or root tip of the embryo, and in due course the cotyledons or seed leaves with the young shoot apex between them are successfully drawn out from the seed coats and enclosing stone, and expand in the air

The walnut, *Juglans*, the shell of which again is a fruit structure behaves much like the plum on germination, the shell splitting into its two component halves Here, however, there is the difference that the shell is formed by the close adhesion of two carpels each half of the shell being a separate entity

(To be continued)

Mitogenetic Radiation and Bioluminescence

By DR J B BATEMAN

THIS article is occasioned by recent popular descriptions [1] of an apparently well attested case of luminescence in a human being in Italy and the references to mitogenetic radiation which accompany them The subject is a woman suffering from asthma She is psychologically abnormal —intensely religious and hysterical—and the phenomenon of light emission occurs during light sleep in circumstances which suggest that it is connected with these abnormalities It lasts about three seconds is of sufficiently high intensity to be photographed with an exposure of one sixteenth of a second and is accompanied by increased respiratory movements greatly increased pulse rate and by the utterance of moaning sounds and expressions

The phenomenon is certainly unusual The Italian peasants are said to regard it as a manifestation of holiness Signor Protti[5] attributes it less picturesquely and perhaps less correctly to the action of blood radiation in causing luminescence of certain substances in the skin Protti s explanation is very unconventional for bioluminescence is generally supposed to be a type of chemiluminescence produced during the oxidation of certain substances the luciferins in presence of enzymes known as luciferases[6] Naturally this mechanism has not been demonstrated in the rare cases of luminescence in human beings but one would hesitate to accept an entirely different kind of explanation without strong positive evidence in its favour It is possible that some instances of human luminescence are due only to infection by luminous bacteria

The casual references to blood radiation are presumably intended to imply that the existence of such radiation is firmly established and its nature quite generally known This is not the case The fundamental experiment of Gurwitsch claiming to show the emission of radiation from an onion root tip which could stimulate mitoses in a second root placed near it has been and continues to be subjected to severe criticism Indeed the state of the subject at present makes a final decision with regard to the validity of this experiment quite impossible This uncertainty has not however deterred Gurwitsch and his pupils from an elaborate development of their ideas both experimental and speculative unfortunately there are contradictions at almost every stage

The supposed identity of the radiation with short wave ultra violet light fundamental to the most important later experiments itself rests on contradiction the resolution of which should have been the primary object of later research Thus although behaving in certain experiments like ultra violet light (being transmitted by quartz and absorbed by glass etc) mitogenetic radiation can pass without being significantly absorbed along the interior of an onion root or through a considerable thickness of a suspension of yeast in beer wort Further there is no agreement with regard to wave length Gurwitsch[7] by experiments with filters and by spectral dispersion of the radiation found a wave length 190–250 mμ Reiter and Gabor[8] by the same means found 340 mμ and both sets of workers were able to confirm fully their own conclusions by experiments with ultra violet light from artificial sources Ignoring or explaining away these very serious discrepancies Gurwitsch continues to regard mitogenetic radiation as ultra violet radiation of wave length 190–250 mμ

If this contention is correct it should be possible to detect mitogenetic radiation by purely physical means but satisfactory evidence is unfortunately lacking Positive results obtained with a photosensitive form of the Geiger Muller electron counter[9, 10] the most sensitive apparatus available are offset by several negative results[11, 12] and the latter also demonstrate how easily spurious positive effects can be obtained if experimental conditions are not properly controlled The most recent experiments[13] suggest that mitogenetic radiation if it exists cannot be detected by any known physical method its intensity is certainly less than about 300 $h\nu$/cm ^{2} sec

There is no space for a more detailed discussion some quite characteristic points have already been referred to in NATURE[14] and a detailed review will appear elsewhere[15] It is only important for the present to note that references to mitogenetic radiation and with them Protti s reference to blood radiation should be regarded with scepticism Even if mitogenetic radiation exists it is almost certainly too feeble to be capable of causing emission of visible fluorescence Protti s explanation for his remarkable case of bioluminescence is therefore to be rejected

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[1] *Times* April 7 1934

[2] *ibid* April 12

[3] *ibid* May 5

Observer April 22 1934

Protti *Illustrated London News* May 19 1934

[6] Newton Harvey The Nature of Animal Light (Lippincott Philadelphia 1920)

Gurwitsch Das Problem der Zellteilung physiologisch betrachtet (Berlin 1926) Die Mitogenetische Strahlung (Berlin 1932)

[8] Reiter and Gabor Zellteilung und Strahlung *Sonderheft der wissenschaftlichen Veröffentlichungen aus dem Siemens Konzern* (Berlin 1928)

[9] Rajewsky *Phys Z* 32 121 1931 Zehn Jahre Forschung auf dem physikalisch medizinischen Grenzgebiet. Herausgegeben von F Dessauer (Leipzig 1931)

[10] Frank and Rodionow *Biochem Z* 249 322 1932
Seyfert *Jb wiss Bot* 76, 747 1932

[12] Grav and Ouellet *Proc Roy Soc* B 114 1 1933

[13] Kreuchen and Bateman in press
Hill NATURE 131 501 April 8 1933

[15] Bateman *Biol. Rev* in press

Obituary

CARL OLOF LUNDHOLM

CARL OLOF LUNDHOLM who died on May 8, at the ripe age of eighty four years, was born in Sweden in 1850 His father was Court Quartermaster and had filled this important office, which however is now extinct, to four of Sweden's kings He was what we would now designate a chemical engineer, though the term was then not known Through the personal influence of his great fellow countryman, Alfred Nobel, he obtained facilities for studying the manufacture of fulminate of mercury in a French factory on the outskirts of Paris Largely as the result of this special knowledge he was invited to join the staff of the Nobel Explosives Co , Glasgow, in 1878

This company, which was brought into being to exploit Nobel's discoveries in the realm of high explosives, had at that time established two factories in Scotland one at Ardeer, Ayrshire, where nitro-glycerine explosives were made, and another at Polmont, Stirlingshire, where detonators were made Both of these branches of manufacture were at that time extremely hazardous and accidents were fairly frequent With both of them Lundholm became intimately associated and on both he left the impress of his strong and courageous personality He was most assiduous in improving the safety factor while increasing efficiency, and the industry to day, considered from the world point of view, is a monument to his ingenuity and foresight This, indeed, is generally recognised, even though the great public never knew very much about him, as he never courted publicity in any shape or form

Lundholm became manager of the Ardeer factory in 1889 and retired from that position in 1909 to become technical adviser to the Nobel Dynamite Trust, with headquarters in London On the outbreak of the War this Trust automatically came to an end, as did also Lundholm's thirty-six years' intimate association with the high explosives industry But even in his retirement he maintained his interest to the very end, and though in later years afflicted by blindness, he kept up a world wide correspondence with old and new friends associated with the industry Indeed, until a few days before his death, he was actively engaged on the writing up of his early experiences in the development of high explosives

Although Lundholm was a member of many societies, he was not a writer of papers, though he inspired many On the other hand, he did recognise the value of research, and with the encouragement of his board, he inaugurated what was probably the first research laboratory in the British Isles His name appears fairly frequently, too, on patent specifications

Lundholm was known to everyone in 'explosives' circles, and during his period of management at Ardeer he must have had thousands of callers from all over the world By those of them who are still alive, his loss will be keenly felt, for he was a kindly soul and was always ready to help and encourage young men He was, however, a stern but just disciplinarian and in times of danger, and these were not infrequent in the early days, he was cool and collected and always master of the situation

WILLIAM CULLEN

THE REV J H HOLMES

JOHN HENRY HOLMES, who died on April 19, was born on June 19, 1866 Having been ordained in 1893, he was appointed by the London Missionary Society at first to the Fly River District, Papua, and a year later to the Elema District (Gulf of Papua) , he settled at Jokea in November 1894 In 1897 he removed to Orokolo, and in 1910 he finally settled at Uriki in the Purari Delta He left Papua at the end of 1917 and, having retired from active service, returned to England in 1920 Thus for more than twenty years "Homu" laboured among two of the most interesting of the peoples of the 'Papuan' stock, about whom previously there was but scanty and often erroneous information

Mr Holmes had a genuine regard for and sympathy with his people, and he recognised that, in order to understand their point of view, it was first necessary to have a thorough command of their language and then to study their customs and beliefs He wrote short papers on the initiation and religious ideas of the Elema tribes (*J. Anth Inst* , 418–431 , 1902), on their distribution and history (*J Anth Inst* , 125–134 , 1903), on their totemism and social conditions (*Man*, Nos 2 10 , 1905) and on their toys and games (*J Roy Anth Inst* , 280–288 , 1908) He also published a preliminary study of the Namau language, Purari Delta (*J Roy Anth Inst* , 124–142 , 1913) It was not until 1924 that he collected his observations in a book on a comparison of the Purari and Gulf natives ("In Primitive New Guinea') Finally, in 1926, he published "Way Back in Papua", in which he attempted in narrative form to give a picture of the old native ways of looking at things and of the effects of the introduction of Christianity

Unfortunately, Mr Holmes had received no scientific training, so there is a lack of precision in many aspects of his work , nevertheless, he has given us very valuable accounts of the ethnography of his two areas, and thus he takes an honourable place among those missionaries who have materially added to our knowledge of backward peoples

A C HADDON

SIR MAX MUSPRATT, Bt

THE public career of Sir Max Muspratt, who died on April 20 at the age of sixty-two years, is very well known He was the third generation of a family of chemical manufacturers His father, the late E K Muspratt, built the Muspratt Laboratory of Physical Chemistry at the University of Liverpool, and Sir Max was brought up in a scientific atmosphere He was one of the first of the great modern industrialists to receive a chemical education He was educated at Clifton College, and from there he went to Zurich, where he received the Swiss Government's diploma in applied chemistry

I have the most lively recollection of lunching with Sir Max Muspratt and Prof Donnan twenty seven years ago, on which occasion Sir Max expressed that extraordinary interest in science, an enthusiasm for research, which never left him

It is not too much to say that Sir Max Muspratt had a large part in bringing about the growth of the large research establishments in which Great Britain can justly pride itself In spite of the fact that his latter years were clouded by great personal misfortunes, he was always willing and anxious to discuss any scientific subject, not so much as regards its direct practical bearing, but in general terms His death is regretted by a far larger number of people than he would have imagined

F A FREETH

WE regret to announce the following deaths

Prof H G Chapman, director of cancer research in the University of Sydney, president of the Linnean Society of New South Wales in 1917-18, on May 25, aged fifty five years

Prof G C Comstock, emeritus director of the Washburn Observatory and professor of astronomy in the University of Wisconsin, on May 11, aged seventy nine years

Prof Otto J Kauffmann, emeritus professor of medicine in the University of Birmingham, on May 15, aged seventy one years

Prof J Y Simpson, professor of natural science in New College, Edinburgh, known for his work on the re interpretation of religion in the light of modern biology, on May 20, aged sixty years

News and Views

King's Birthday Honours

THE King's birthday honours list includes the names of the following men of science and others associated with scientific work and development *Baron* Sir Hugo Hirst, chairman and managing director of the General Electric Company, Ltd *G.B.E* Sir John Reith, Director General of the British Broadcasting Corporation *K.B.E* Dr F G Banting Dominion of Canada, discoverer of insulin *Knights* Major R G Archibald, director of the Wellcome Tropical Research Laboratories, Sudan, Mr A W Flux, honorary vice president (past president) of the Royal Statistical Society, Mr Albert Howard, lately agricultural adviser to the States in Central India and Rajputana, Dr W H Moberly, vice chancellor of the University of Manchester, Dr C E Saunders, lately Dominion cerealist, Dominion of Canada, discoverer of Marquis Ruby, Reward and Garnet Wheat, Prof G Elliot Smith, professor of anatomy in the University of London (University College) *C B* Dr R E Stradling, director of Building and Road Research, Department of Scientific and Industrial Research *C.M G* Mr A C Bagshawe, secretary of the Department of Agriculture and Lands, Southern Rhodesia, Prof R S Troup, director of the Imperial Forestry Institute and professor of forestry in the University of Oxford, for services to forestry in the Colonies *C.I.E* Mr F Canning, chief conservator of forests, United Provinces, Mr P E Aitchison, chief conservator of forests, Bombay Presidency; Mr W McRae, director and Imperial mycologist, Imperial Institute of Agricultural Research, Pusa *C.B.E* Dr W L Balls, chief botanist, Egyptian Ministry of Agriculture, Mr L St L Pendred, editor in-chief of the *Engineer*, Dr L J Spencer, keeper of minerals, British Museum (Natural History). *O.B.E* Dr S G Barker, for research services to the Empire Marketing Board, Mr A D Cotton keeper of the Herbarium and Library, Royal Botanic Gardens, Kew, Miss E H Ekins, principal of Studley Horticultural and Agricultural College for Women, Miss Annie Lorrain Smith, for contributions to mycology and lichenology, Dr C Raeburn assistant director of the Geological Survey Department, Nigeria *M B E* Mr F G Harcourt curator of the Botanical Gardens and Agricultural Superintendent, Dominica Leeward Islands, Mr J D Kennedy, sylviculturist, Nigeria *I.S O* Mr G E Greig, lately senior warden of mines, Federated Malay States

Johann Bauschinger, 1834–93

AMONG those to whom German industry and engineering owed much in the latter part of last century was Johann Bauschinger, who was born on June 11 a century ago He began life as a school teacher, but became very widely known for his work on the testing of materials One of a large family of an artisan, Bauschinger was born in Nuremberg and was educated at the Nuremberg Commercial School, and the Polytechnic He was enabled to proceed to the University of Munich and, after studying mathematics and physics at the age of twenty three years he secured a post as teacher in the Commercial School at Fürth, where he spent nine years He then taught for a time in the Realgymnasium of Munich, and in 1868 was appointed professor of mechanics and graphic statics in the Technical High School there, which henceforth was the scene of his activities By 1870, he was in possession of a mechanical laboratory where, said Unwin, "Engineering experiments were carried out with a thoroughness and delicate accuracy never previously equalled"

He designed a new form of testing machine and applied Gauss's method of reading by reflection in instruments for measuring deformation of bodies when strained, made tests of cement, mortar, timber, cast iron, wrought iron and steel, and for the railway authorities made investigations on defective axles, rails, etc Much of his work was inspired by the labours of his famous countryman August Wöhler (1819–1914) An important outcome of Bauschinger's labours was the formation in Germany of a society for exchanging views on investigations similar to his own, and thus led to the foundation of the International Association for Testing Materials In his own particular line, he was regarded by Unwin as "the prince of observers" He died at Munich on November 25, 1893

Preparations for New Ascents into the Stratosphere

The National Geographic Society, Washington, D C, is co-operating with the U S Army Air Corps and other donors in a new ascent to the stratosphere to be made this month According to the *National Geographic Magazine* of April, the balloon to be used will have a capacity of 3,000,000 cubic feet, and will be manned by Maj William E Kepner and Capt Albert W Stevens The balloon fabric is of cotton impregnated with rubber, and the spherical gondola, which is made of a magnesium aluminium alloy is 8 ft 4 in in diameter The total weight to be raised including balloon, gondola equipment and crew, is nearly eight tons It is estimated that when the balloon rises from the earth partly inflated, the top will be 295 ft from the ground, at its 'ceiling', the balloon will be a sphere 180 ft in diameter Hydrogen is to be used for inflating it The gas valve in the top of the balloon will be operated from the gondola by compressed air The programme of scientific work includes the collection of samples of the atmosphere of the stratosphere, determination of electric gradient, observations of cosmic rays and of ozone content and photography at great heights According to the Brussels correspondent of the *Times*, Dr Max Cosyns, who accompanied Prof Piccard on his second ascent to the stratosphere, has completed his preparations for a new ascent (Nature, Nov 25, 1933, p 812) The gondola of the Belgian balloon has been constructed of aluminium

New Paris Zoo

The lures of Paris are many Its latest is a new zoo at Vincennes which should be well worth seeing Hagenbeck, in Germany, was one of the first to abolish the old and hideous system of keeping birds and beasts in cages The Zoological Society of London, when Sir Peter Chalmers Mitchell took over the reins of government, followed suit, starting with the fine sea-lions pond, and the now famous Mappin Terraces These last seem to have inspired the director of the new Paris Gardens, Prof Urbain, and the architect, M Charles Letrosne, for the dominant feature of the Gardens, we are told, is a towering mass of reinforced concrete, 200 ft high, shaped and coloured to look like reddish brown rock, with ledges for sheep, goats, and antelopes The interior of this mass contains two large reservoirs for the storage of water to supply pools in various parts of the Gardens. In the London Mappin Terraces similar reservoirs supply the wonderful Aquarium—the finest in Europe Another noteworthy feature of the Paris Gardens is a great aviary giving the birds plenty of room for flying Occupying an area of about 23 acres, it would seem to be reminiscent of the Gardens of the Zoological Society in London and at Whipsnade, and there is no doubt they will be as much appreciated The new Gardens occupy the site of the Colonial Exhibition in the Bois de Vincennes They were opened on June 2 by the President of the Republic, M Lebrun

The Indian Earthquake of January 15, 1934

This great earthquake is being studied by officers of the Geological Survey of India Their investigations in the central area are expected to last for several weeks longer, and their results will be published by the Survey at an early date In the meantime, three papers of some interest have appeared Sir E Pascoe's lecture on Indian earthquakes and their causes is published by the Royal Society of Arts (*Journal*, 82, 577–594, 1934), and papers on the North Bihar earthquake by Dr M S Krishnan and Dr S K Banerji in *Current Science* (2, 323–326, 326–331, 1934) From the observations so far made, it seems, according to Dr Banerji, that the earthquake fault reaches from Motihari to Monghyr, a distance of about 135 miles There is probably also a second fault, branching from near the middle of the latter and running in the direction of Purnea. Most of the seismographs in India were thrown out of action by the shock, but good records were obtained, and are here reproduced, at Colaba (Bombay) and Agra From the great preponderance of the surface waves compared with the primary and secondary waves, Dr Banerji concludes that the focus was at a very slight depth below the surface All three writers agree in attributing the earthquake to a disturbance of the isostatic compensation

After-Shocks of the Bihar Earthquake

At the end of May, the after shocks of the Bihar earthquake of January 15 increased in frequency and strength The strongest, which occurred at about 1 A M on May 31, seems to have originated within the focus of the principal earthquake, for it caused alarm at Muzaffurpur, Patna and other places in its epicentral area So far as is known, there was no loss of life and no damage except that walls injured in January collapsed, while fissures that had become filled with dust reappeared Shocks were also felt about noon on the same day in Assam, the first of which is reported to have lasted two minutes and to have been felt in Calcutta

Element No 93

The Rome correspondent of the *Times* states, in a short communication published in the issue of June 5, that an article in the *Giornale d'Italia* which surveys recent work on induced radioactivity by Prof Enrico Fermi, of the Royal University, Rome, includes the announcement that Prof Fermi has produced a new element, of atomic number 93 The new element was found when uranium, atomic number 92, was bombarded with neutrons , it is radioactive, with a half period of about 13 minutes This announcement would appear to be a sequel to the experiments reported by Prof Fermi in NATURE of May 19, p 757, when he described the effects of bombarding various elements with a powerful stream of neutrons Uranium was not among the elements mentioned by Prof Fermi in his communication, but it would seem that he has now succeeded in obtaining an effect from it

Science and Psychical Research

EARLY this year (January 6, p 18) we referred to the proposed formation of a body to be called 'The International Institute for Psychical Research", and expressed the hope that the men of science who had allowed their names to appear on the circular announcing the new organisation would see that whatever investigations were undertaken were in accord with what science demands of such inquiries Apparently it has been difficult to secure these essential conditions, for Prof D F Fraser Harris, who was announced as the research officer of the Institute, informs us that he has resigned that position When he invited a number of scientific friends to serve on the Committee of the Institute, he was under the impression that a laboratory was to be provided, but he now finds this is not so, and that there is a lack of appreciation of what scientific investigation signifies It may be recalled that Prof Elliot Smith, who was advertised a short time ago as president of the Institute, resigned a few weeks ago on account of ill health We understand that most of the chief men of science whose names were advertised in the list of members of the Consultative Committee of the Institute have also resigned In connexion with the subject of psychical research, Prof Fraser Harris, referring to the article 'From a Correspondent" in NATURE of May 19, p 747, writes — There is one circumstance not mentioned by the author of the account of the experiments of MM Osty (1932) on 'the unknown powers' produced by Rudi Schneider It is the fact that, between the medium and the sitters on one hand and the recording apparatus on the other, there was interposed a sheet of muslin stretched on a wooden frame Clearly, the medium on one side of this partition, even with all his limbs free and surrounded by any number of accomplices could not have played any tricks with the apparatus on the far side of the partition (A photograph of this screen is on p 54 of *Revue Métapsychique* 1932 No I)"

Tornado at Concepcion

A BRIEF summary of damage and loss of life caused by a tornado on May 27 in the Chilean town of Concepcion, the chief port of entry to southern Chile, appeared in some evening papers on May 28, and in the *Times* of May 29 The storm was described as a "cyclone", but the note in the *Times* stated that the damage occurred in a strip 65 ft wide, and if that statement is correct, there can be no doubt that this was a tornado of the American pattern, and a vigorous example at that, seeing that trees were uprooted and buildings were wrecked as the storm swept across the town, moving apparently from east to west One account stated that a house was lifted off the ground and carried along for a distance of nearly 55 yards The incident is of especial scientific interest , if the 'dust devils' of desert regions and the maritime or lacustrine waterspouts' are included under the term tornado', there appears to be hardly any part of the world where this small intense rotary storm may not occasionally occur , they are not uncommon in the Mediterranean, and Concepcion lies in the corresponding southern latitude and has the same type of climate with maximum rainfall in the winter half of the year It is then that the westerly winds invade a region that fringes the trade wind belt during the summer The date of this particular storm corresponds with late November in the Mediterranean, and in both regions the late autumn is in general about the middle of the wettest quarter of the year, when the tornado might be expected to occur most often in coastal regions, even though the American tornado is more a phenomenon of the late spring and summer

Trevithick Centenary Commemoration

AT a meeting of the general committee of the Trevithick Centenary Commemoration, held on May 31 at the Institution of Civil Engineers and presided over by Sir Murdoch Macdonald, the report of the Executive Committee appointed in October 1932 to make arrangements for the commemoration was presented by Mr H W Dickinson, honorary secretary, and passed The report showed that about £500 had been subscribed, and that the committee had been able to carry through the plans laid down Memorial services were held in Westminster Abbey and Dartford Parish Church, a memorial lecture was delivered by Prof C E Inglis, and memorial tablets have been erected at Merthyr Tydfil to mark the site of Trevithick's experiment of 1804 and at University College, London, to mark the experiment with the locomotive *Catch-me who-can* in 1808 A sum of money had also been allocated to assist in the erection of a tablet at Trevithick's birthplace The work of the committee had been greatly assisted by the hospitality of the Institution of Civil Engineers and by the generosity of Messrs Babcock and Wilcox, Ltd , who had defrayed the cost of the publication of the memorial volume on Trevithick by Messrs Dickinson and Titley An interesting outcome of the celebration was that it had led the Institution of Civil Engineers to appoint a committee to make an annual visitation to Westminster Abbey to inspect the various memorials to engineers there

Expedition to the Canadian Arctic

AN expedition, organised by the Oxford University Exploration Club with the full support of the Royal Geographical Society and the Canadian Government, is sailing shortly for Ellesmere Land in the Canadian

Arctic, under the leadership of Dr Noel Humphreys The plans of the Expedition are to leave London in July in a sealer chartered from Norway and to winter in Ellesmere Land, next spring being devoted to an exploration of Northern Ellesmere Land The interior is unexplored and a geological survey of this country will be the chief scientific work undertaken The Expedition is financed partly by its members and partly by scientific societies and individual subscribers The greater part of the food supply has been obtained free owing to the generosity of a number of firms The Expedition will consist of five or six members, but a geologist is still urgently required Besides being physically fit and prepared to be away from England for a year, he should have had some field experience Communications referring to the Expedition should be addressed to Mr E A A Shackleton, Oxford University Ellesmere Land Expedition, 1934, Royal Geographical Society London S W 7

Archæological Exploration in Alaska

Dr Aleš Hrdlička, accompanied by a number of volunteer students left Washington on May 11 for a further season's work on Kodiak Island Alaska Several seasons have already been devoted by Smithsonian expeditions, of which Dr Hrdlička has been in charge, to the examination of sites on this island The results have shown that it was at one time thickly populated and was in all probability a stepping stone in the peopling of America by migrants from Asia The earliest inhabitants, whose skeletal remains have been found at the bottom of the accumulated debris, represent the earliest remains of man which have been found in the far north They are not, however, ancient in the geological sense In type they approach the physical characters of the Indians of California and the west coast The earliest immigrants introduced a high order of stone culture, and many of the objects found with them are unique They were succeeded by the Aleut, who were the inhabitants at the time of the coming of the Russians A remarkable feature in the culture of the older population is that it is not identical throughout A marked change takes place in the course of their period of occupation In the coming season, work will be confined to one large village, already partially explored The site will be subjected to intensive study in the hope of obtaining a decisive answer to some, at least, of the problems which have been raised in the investigations of previous years

International Eugenics Conference

The biennial conference of the International Federation of Eugenic Organisations will take place at Zurich on July 18–21 under the presidency of Prof Ernst Rüdin of Munich A programme has been arranged providing for the discussion of subjects of immediate interest in which eminent specialists have been invited to take part Addresses will be delivered by, among others, Prof Rüdin on 'Racial Psychiatry—a Scheme for Topographical Research in Europe", Dr Mjoer on Measurement of Psychological Faculty as shown in Musical Ability", and Prof Von Verschuer on "Researches in Twins" Dr Rudin will also explain the provisions of the recent German eugenics law, and it is hoped that one of the public health officers of the Reich will give an address on the questionnaire now used in Germany for assessing intelligence grade Among the subjects down for discussion are the assessment of feeble mindedness—to be held in a joint session of the Committee for Racial Psychiatry and Section B of the International Committee for the Standardisation of Human Measurement—mental measurement and its relation to diagnosis of temperamental type, aspects of the problems of differences between, and inheritance in, monozygotic and dizygotic twins, and the best methods of conducting a central clearing house for human heredity, this last named including the questions of the establishment of national bureaux, and the protection of authors whose material is published The work of the Standardisation Committee in Anthropometry will be continued at the International Congress of Anthropological Sciences to be held in London at the end of July

Prof Erwin Baur

Heft 17 18 of *Die Naturwissenschaften*, which appeared on April 27 is devoted to the memory of Erwin Baur, who died in December last A short general account by Dr Max Hartmann of his work and its significance in leading to a general appreciation of genetics in Germany is followed by a series of twelve articles written by colleagues of Baur whom he trained in the institute of which he was head outlining in more detail the results achieved by the institute for plant breeding which he founded at Muncheberg Five papers dealing with his theoretical work discuss respectively his investigations of mutation, linkage, specific crossing and self sterility in *Antirrhinum*, and his genetical work on *Pelargonium* and *Cleome* In seven other papers are considered the practical plant breeding results obtained with rye, wheat, barley sweet lupins fodder plants potatoes and grapes Further papers on the practical results will appear in later numbers of the same journal An obituary notice of Prof Baur appeared in Nature of February 17

Barter in Great Britain

In the United States the direct barter of goods and services has developed rapidly since 1931 as a practical method of alleviating unemployment and social distress So far, little appears to have been done in Great Britain along similar lines, possibly because social insurance is highly developed, whereas in the United States it is practically non-existent It is of interest therefore to note that, according to *Progress and the Scientific Worker*, experimental barter schemes have been inaugurated near Cheltenham and Petersfield The Cheltenham scheme was started under the leadership of Prof Scott of University College, Cardiff Four acres of land were purchased to be cultivated co-operatively by a group of men. They receive no remuneration for their work other than coupons signed by Prof. Scott according to the time spent on work. These coupons are equivalent in value to half a pound of potatoes, and can also be exchanged for knitted socks made by a member or for boot repairs undertaken by another member. Later on, it is hoped to extend the variety of goods and services obtainable for the coupons. At Petersfield the system is further developed and the work undertaken by various members includes cultivation of allotments, poultry farming, wood cutting, cobbling, carpentry and general repairs. To break up the land a tractor has been borrowed from a local firm. The commodities or services are exchanged among the members while surplus farm produce is sent to an occupation centre in exchange for surplus clothes made in the centre.

Gutta Percha, Balata and Caoutchouc

PROF. G. G. HENDERSON in delivering the twenty-sixth Bedson Lecture in Newcastle upon Tyne on May 18 outlined the work carried out in his laboratories on the subjects of gutta percha, balata and caoutchouc. The peculiar difficulties of the subject—which he advised research workers to avoid—are the lack of criteria of purity, complete absence of crystalline compounds, ready resinification at temperatures above 40° and attack by air. Oxidation experiments with hydrogen peroxide yielded alcoholic substances in each case, which when treated successively with acetic anhydride, further peroxide and aqueous barium hydroxide gave from each source, so far as could be determined, the same final alcoholic product. Hydrogenation with a palladium catalyst gave results in agreement with the general formulæ $(C_5H_8)_x \rightarrow (C_5H_{10})_x$ with the anticipated increase in stability. This is in agreement with the general conception of chains of isoprene units linked head to tail with loss of one double bond per unit. The hydrochlorides of these substances on treatment with metallic zinc gave, not the same dihydrides, but quite different substances with the original empirical formula but one unsaturated linkage to each two isoprene units, which may be due to cyclisation on loss of hydrogen chloride. Finally, the dibromo addition compounds condensed with phenols in the presence of anhydrous ferric chloride to yield coloured substances with the properties of indicators, one being very suitable for the titration of halides with silver nitrate.

Marine Electrification

SEVERAL important developments in connexion with marine electrification are described in the *G.E.C. Journal* of February. In the past, fishing trawlers have been illuminated by means of carbide lamps which, apart from their disadvantages from an illuminating point of view, introduce a serious fire risk. Special equipment has now been designed and installed on one of the trawlers of a Scottish fishing fleet which enables electric lighting to be used. The installation has been very successful and the practice of electrically floodlighting the decks of trawlers will be widely used. The Company also completed the electrical propulsion equipment of the Diesel-electric tug, *Acklam Cross*. This is the first British vessel of her type, the first to have high speed Diesel prime movers, the first to have a clear after deck, and the first to have an electrical system of starting the prime movers. The system adopted seems admirably suited to fulfil all the special requirements of a tug. It is capable of going on duty at a moment's notice. It is also capable of rapid manœuvring when towing large vessels in and out of congested harbours. There is practically no delay in exerting full power ahead or astern. The Diesel-electric engine can be started up as quickly as a motor car engine and during periods of inactivity no fuel at all is consumed. The control of the speed and the direction of the controller is directly in the hands of the navigating officer. Starting is effected immediately by pressing a button. The mean speed over the measured mile was 11.15 knots. The time taken from rest to full speed ahead was 24 seconds and from stop to full astern was 16 seconds. The electro-hydraulic steering gear was very efficient, the vessel being capable of turning at full speed in under two lengths.

Research Activities of the Mellon Institute

THE twenty-first annual report of the Director of the Mellon Institute, covering the year 1933–34, directs attention to the improvement in the position of research during recent months and illustrates the wide range of industries which benefit from the activities of the Institute. Sixty-six industrial fellowships were in operation during the year requiring the services of 101 fellows and 34 assistants, and fifty-five fellowships were in operation at the end of the year. Fellows and assistants then numbered 104 as against 98 in the previous year; new fellowships commencing operations during the year dealt with cosmetics, nitrogen compounds, calgonising, rayon, new plastics, phosphates, tar acids, textile finishing, etc. The calgonising fellowship is concerned with the properties and utility of sodium metaphosphate ('calgon') in textile and laundry technology, the fellowship on phosphates is occupied with their pharmacology and therapeutic value, and a fellowship to investigate problems in starch technology has recently been accepted. The discovery of a process for flaking coffee by the application of high pressure to ground freshly roasted coffee made in a study of the packing of coffee is claimed as an important technical and practical advance. Other investigations have led to the marketing of new and improved strained foods. Industrial applications of the newer organic solvents have been assisted and a new water-soluble lubricant has been introduced for worsteds and wool. New plasticisers, new types of resins, adhesives which do not cause discoloration of envelopes on sealing, the synthesis of new types of amines, are among other achievements of the Institute, which can also point to important investigations on steel, the development of novel building materials, studies on heat insulation and efforts at smoke abatement as other evidence of its importance to the general welfare The fellows of the pure chemistry department have completed a number of important investigations on quinine, the cinchona alkaloids, etc , while the Institute has also supported investigations on pneumonia and pulmonary diseases at the Western Pennsylvania Hospital

Aquarist and Pond Keeper

THE sixth volume of the *Aquarist and Pond Keeper*, which opens with the March–April issue, has a change of cover, a new headpiece and other improvements in printing and illustrations The magazine keeps up its character in every way, and is full of information for those who are fond of aquaria, vivaria and pond culture The articles in the present number include the first of a new series by Arthur Denham on the keeping, breeding and rearing of tropical fishes, and aquarium notes by E G Boulenger, director of the Zoological Society s aquarium, and by S W Weller, curator of the Brighton Aquarium An angler fish or 'fishing frog' more than three feet in length, said to be the finest specimen of its kind ever exhibited alive, has been acquired for the Brighton Aquarium It will be interesting to see how long it lives, for this species is notoriously difficult to keep in confinement, especially those of such a large size

The Merseyside Aquarium Society

ONE of the most extensive collections of British fresh water aquaria and aquatic and river side vegetation, in addition to foreign aquaria, has lately been brought together by the Merseyside Aquarium Society at its aquarium at Cliff House, Wallasey which was opened by the Mayor of Wallasey in March 1932 The collection, which now comprises some sixty tanks, is claimed to be the most extensive of its kind in the North of England and situated in extensive glass houses, is largely the result of much hard work by enthusiasts in all classes of life in an effort to establish a really efficient scientific and public aquarium on Merseyside The Merseyside Aquarium Society was instituted in 1926, largely through the efforts of Mr F Jefferies, a past president of the Liverpool Naturalists' Field Club, and incorporated in 1930, and its first president was the late Prof James Johnstone The president of the Society is Alderman A H Evans of Wallasey, the vice-presidents Prof J H Orton, professor of zoology in the University of Liverpool, W S Laverock, lately of the Liverpool Museums, and Alderman D R Charlesworth, ex mayor of Wallasey, and the honorary secretary, Mr F Jefferies By a system of exchange, the Cliff Aquarium has acquired a number of valuable exhibits from the New York Aquarium Society, and it has lately been successful in breeding and rearing the axolotl (*Amblystoma*) to maturity The present premises have been loaned the Society by the Wallasey Corporation, but the Aquarium is only considered a nucleus for a much larger building which it is hoped to have built as a municipal affair in the future. The Society issues a volume of *Proceedings*, holds six indoor meetings annually, and affords special help for the amateur aquarists, for the exchange of knowledge and experience amongst experts, and to promote school aquaria and vivaria

Advances in Oceanographical Research

THE great and growing importance of fundamental research in marine biology and oceanography has recently been emphasised by the launch of two new vessels specially ordered and designed for this work On September 23, 1933, a new French research vessel, the *Président Théodore Tissier*, left the builder's yard This ship, built to the order of L'Office Scientifique et Technique des Pêches Maritimes de France, is approximately 160 ft in length, fitted with up to-date Diesel engines capable of producing a maximum speed of 11 knots, and fully equipped with all the latest apparatus for both oceanographical and biological researches The *Président-Théodore-Tissier* has now completed her trials and is already in commission A few months before the launch of the French vessel, the Danish Biological Station, Copenhagen, took over from the builders the new research ship *Biologen* (Report of the Danish Biological Station to the Ministry of Shipping and Fisheries, 38, 1933 Copenhagen C A Reitzel) Though considerably smaller than the *Président-Théodore Tissier*, the Danish vessel is also fully equipped for carrying out scientific work in both narrow and high seas In view of the acquisition of these two highly efficient modern research vessels by foreign powers, it is all the more regrettable that H M S *Challenger*, originally destined for similar work by Great Britain, should have had to be given over to other purposes, and the activities of our existing ships seriously curtailed

A Potato Research Station

THE establishment of such a station in one of the important potato growing districts is advocated by Sir John Russell in the foreword to the report of the sixteenth Rothamsted Conference upon Problems of Potato Growing" (Harpenden Rothamsted Experimental Station 2*s*) Sir John concludes that economical production of potatoes necessitates the use of good seed of the most suitable varieties, appropriate schemes of manuring and cultivation, control of insect and fungus pests and of other agencies causing disease and methods for dealing with excess produce All these topics are dealt with by expert contributors in this report The fields of research developed around this homely plant, notably the virus disease problems, show how technical and specialised are the problems raised by this crop, and though the present research and advisory system deals very effectively with them to a point, Sir John concludes that there is room for such a special research station continuously concerned with investigations into the physiology of the potato and the utilisation of the tuber

Research Regulations in Germany

THE April number of the *Fight Against Disease*, the quarterly journal of the Research Defence Society, among other matter, gives extracts from the new German law controlling vivisection, which show that the German regulations governing experiments on living animals are substantially the same as those which have been enforced by the Home Secretary in Great Britain for more than half a century

National Baby Week Council

THE annual report of this Council, recently issued, describes the work accomplished during 1933 and constitutes another record of increased activity and influence A tribute is paid to the co-operation of the Press and of shops and stores in propaganda respecting maternity and child welfare problems It is suggested that propaganda should this year be devoted to the subject of The Making of an A 1 Nation", and National Baby Week' is to be celebrated on July 1–7 The Council has suffered from the financial stringency, but by exercising the strictest economy, income for the year exceeded expenditure by the small margin of about £12

South-Eastern Union of Scientific Societies

THE thirty ninth Annual Congress of the South Eastern Union of Scientific Societies will be held at the University of Reading on July 11–14 under the presidency of Prof H L Hawkins, professor of geology in the University On July 11, Prof Hawkins will deliver his presidential address entitled Fossils and Men" The presidents of sections will deliver the following addresses during the Congress T D Kendrick (Archæology), The Art and Archæology of the Early Anglo Saxons', Dr Macgregor Skene (Botany), Some Problems of Germination", Dr C B Williams (Zoology), Insect Immigration in Great Britain', T H Edmunds (Geology), "The Water Supply and Geology of the South East of England, C H Grinling (Regional Survey), Surrey for Action" On July 13, at 8 p m, Prof E B Poulton will deliver a public lecture entitled The Power of Changing Colour as a Form of Protective Resemblance" Further information can be obtained from the Hon General Secretary, 14, High View Close, Norwood, S E 19

American Academy of Arts and Sciences

AT the annual meeting of the American Academy of Arts and Sciences held on May 9, the following officers were elected for 1934–35 *President*, Prof G H Parker, *Corresponding Secretary*, Prof Tenney L Davis, *Recording Secretary*, W E Clark, *Treasurer*, I Bowditch, *Librarian*, Prof Alfred C Lane, *Editor*, Prof Robert P Bigelow, *Foreign Honorary Members*, Prof R A Fisher, Galton professor of eugenics in University College, London; Prof A V Hill, Foulerton Research professor of the Royal Society, and University professor of physiology in University College, London, Prof Arthur H Holmes, professor of geology in the University of Durham, Prof Paul Janet, professor of electrotechnics in the Sorbonne, Paris, Prof Luigi Lombardi, Rome, and Prof R Willstätter, Munich

Announcements

PROF A V HILL will open a discussion at the Royal Society on June 14 on "Methods of Measuring and Factors Determining the Speed of Chemical Reaction"

THE RIGHT HON WALTER E ELLIOT, Minister of Agriculture and Fisheries, will inspect the field plots and laboratories of the Rothamsted Experimental Station on June 20, at 11 15 a.m On the same day, Mr Elliot will present to the Trustees the deeds of the land newly acquired as a result of the recent public appeal

PROF J B CONANT, president of Harvard University, formerly professor of chemistry in the University, has been awarded the medal of the American Institute of Chemists The award is made in recognition of 'outstanding service to the science of chemistry and the profession of chemists in America Prof Conant is well known for his work on reduction and oxidation in organic chemistry, and on hæmoglobin and chlorophyll

WE have received the second supplement, 1931–1933, to the Catalogue of Lewis's Medical and Scientific Lending Library' (London Lewis's Library, 136, Gower Street, London, W C 1 2*s* net) Works are listed alphabetically under authors' names, and at the end there is a classified index of subjects, under each of which authors' names are given, and the full title of the works will be found on reference to the body of the catalogue All the sciences appear to be represented, and the list contains nearly 3,000 titles

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —An assistant lecturer in physics in King's College, London —The Secretary (June 12) A veterinary officer to the Berkshire County Council—The Clerk, Shire Hall, Reading (June 19) Assistant lecturers in geology and geography chemistry, and physics at University College, Swansea—The Registrar (June 20) A superintendent of parks in the Borough of Barking—The Town Clerk, Town Hall, Barking (June 20) A lecturer (woman) in geography at Norwich Training College—The Principal (June 20) An inspector of agriculture in the Department of Agriculture and Forests, Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S W 1 (June 21) A lecturer in pure and applied technology at Leicester College of Technology—The Director of Education (June 22) An assistant in the Department of Natural Philosophy in the University of St Andrews—The Secretary (June 23) A senior lecturer in mathematics at the Huguenot University College, Wellington, Cape Province, South Africa—The Registrar (Aug 14) Evening teachers of pure and applied mathematics, economics, economic geography, etc, at the Wandsworth Technical Institute, London, S W 18—The Secretary

ERRATUM NATURE, June 2, p 837 "Chemistry of Red and Brown Algæ" For "polymerised uronic acid" read 'polymerised mannuronic acid"

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Activities of Life and the Second Law of Thermodynamics

WE regret the necessity of prolonging this discussion but in spite of the letter of Sir James Jeans[1] we persist in the conviction that it is his reasoning not ours which is fallacious We are quite aware that the change of positional entropy associated with the type of process which he cites involves the factor Nk where k is the Boltzmann constant and N the number of particles concerned in the process nor do we dispute the correctness of the well known formulæ which he quotes We must however point out that he is wrong in assuming that the number of particles *must* coincide with the number of molecules We might ask why not the number of atoms or the number of protons and electrons ? The answer is that for a given process of redistribution the particles are those units whose relationship to one another is altered but whose internal structure remains unaffected In the process of sorting out trucks each truck is to be reckoned as a particle in the process of steering the *Mauretania* the ship is a particle

To revert to the type of case originally considered by Sir James Jeans let us imagine a large number of equal spheres of glass on a frictionless horizontal plane If N of these spheres be moved from a place where the (superficial) density of distribution of the spheres is v to a place of higher density v^1 then the decrease of positional entropy of the system is equal to kN $(\log v^1 - \log v)$ According to Sir James Jeans however the decrease of positional entropy would be kn_1N $(\log v^1 - \log v)$ where n_1 is the number of molecules contained in each sphere If he reasons in this manner we would ask him why the decrease of positional entropy should not also be kn_2N $(\log v^1 - \log v)$ where n_2 is the number of atoms or the number of protons and electrons contained in each sphere This paradox clearly reveals the fallacy in his reasoning

Finally we would point out that the total entropy of an assembly of N identical systems each made up of n ultimate particles may be resolved into the sum of two terms the first of the order Nk determined by the configuration (and relative motion) of the centres of mass of the N systems the second of the order $N(n - 1)k$ determined by the internal arrangement of the ultimate particles in each system In any process in which the internal arrangement of the systems remains unchanged only the *first* term in the entropy is affected We think it scarcely possible that Sir James Jeans would dispute this statement although the views expressed in his last letter contradict it

F G DONNAN

University College London

E A GUGGENHEIM

University, Reading

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[1] NATURE, 133, 612 April 21 1934.

Calcium Isotopes and the Problem of Potassium

BY the systematic use of the purest materials, I have succeeded in reducing the effect of potassium in the mass spectrum of calcium to a negligible quantity Under these conditions the line 41 disappears completely and it is quite safe to conclude that the isotope Ca 41 does not exist at least to 1 part in 1000 in the element Photometry gives the following provisional constitution for calcium

Mass numbers	40	42	43	44
Abundance	97	0 8	0 2	2 3

It will be noted that the abundance of Ca 44 is much greater than that originally reported by Dempster[1] and is in better accord with the chemical atomic weight

I have been kindly supplied with compounds of calcium extracted from biotite by Prof G v Hevesy and from pegmatites from Rhiconich and Portsoy by Prof J Kendall On the view that the radioactivity of potassium is due to the simple beta ray transformation of K 41 to Ca 41 these samples should be rich in the latter On analysis their mass spectra showed no appreciable difference from that of ordinary calcium so that the abnormal atomic weights reported by Kendall[2] cannot be ascribed to the presence of the hypothetical isotope 41

Hevesy s beautiful distillation experiments have shown that the radioactivity of potassium is unlikely to be associated with the abundant light isotope 39 so that the failure to detect Ca 41 appears to favour some more complex theory of the disintegration such as that recently suggested by Gamow[3]

F W ASTON

Cavendish Laboratory
Cambridge
June 1

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[1] *Phys Rev*, 20 633, 1922.

[2] NATURE 131 688 May 13 1933

[3] NATURE 133 746 May 19 1934

Interaction of Radio Waves

IN our letter published in NATURE of February 10 last Dr Martyn and I stated that we had found that Tellegen s observation of an apparent interaction of radio waves could be explained by taking account of the changes in the mean velocity of agitation of electrons in the ionosphere produced by a strong electric wave

Another interesting consequence of this effect due to an electric wave may be pointed out namely the production of so called atmospherics in a radio receiver by modulation of the received carrier wave

An atmospheric electric pulse acting on the electrons in a part of the ionosphere through which the carrier wave passes momentarily increases the absorbing power of that part and so momentarily reduces the amplitude of the received carrier wave Thus an irregular succession of sounds is produced in the receiver similar to the effects produced more directly by atmospheric pulses

Thus it appears possible that observed atmospherics are of two types one associated with and proportional to the intensity of the carrier wave and the other completely independent of the carrier wave

V A BAILEY

Department of Physics
University of Sydney
April 11

Pseudorca crassidens (Owen) on the Glamorgan Coast

DURING the night of Sunday, May 6, a school of cetaceans was stranded at Whiteford Sands, Llanmadog, on the Gower coast of Glamorgan We visited the spot as soon as possible and found twenty one specimens, which we identified as False Killers, *Pseudorca crassidens* (Owen) Mr M A C Hinton, who has examined one of the skulls, agrees with the identification It was possible to make a more or less detailed examination of these and to procure some material for this Museum, another specimen, which was not reported to us until later, was some distance away and we did not have an opportunity of examining it

[*Photo Western Mail and Echo, Ltd.*

FIG 1. False killer dolphins stranded on Glamorgan coast on May 6, 1934.

It will be remembered that this dolphin was by many considered to be one of the rarest of cetaceans, "on the verge of extinction", until October 1927, when a school of about 130 was stranded in the Dornoch Firth In December 1928 a still larger school was reported from the South African coast, near Cape Town, and another school from Velanai Island, near Kayts, in Ceylon, in August 1929 Sir Sidney Harmer, in a letter to these columns[1], gave a summary of occurrences of this species and suggested that its supposed rarity was due to its being an inhabitant of the open seas and thus seldom observed in the neighbourhood of land

A certain amount of data of biological interest has been obtained about the Llanmadog specimens, and it is hoped to publish this in due course

COLIN MATHESON
LIONEL F COWLEY

Department of Zoology,
National Museum of Wales,
Cardiff

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[1] NATURE, 127, 60, Jan. 10, 1931.

Meteorology and Gliding

IN a letter to NATURE of May 5, Mr G E Collins asks whether a sensitive thermometer would be useful on a sailplane for detecting rising air, and desires indications as to how sailplane pilots can assist the science of meteorology

To make satisfactory measurements of temperature and humidity inside and outside clouds by carrying a meteorograph on an aeroplane is difficult, because the instruments at present made are not nearly rapid enough in their responses to record features lasting about a second, and in Germany they have developed a scheme whereby the more slowly moving sailplane carries the self recording apparatus and is towed by an aeroplane to the region where observations are required, because the demands for rapidity in the meteorograph will then be less severe

In the absence of a special institution devoted to these purposes, measurements of the variations of temperature and humidity are difficult, but information of value to the gliding movement as well as to meteorology could be got by systematic measurements, or careful estimates, of the vertical air movements in the neighbourhood of clouds of the different types, especially if the type were defined by the use of a camera Thus on March 18, the day when Mr Miles, Mr Collins and Mr Humphries all made long flights, some of the verbal descriptions that I heard indicated line squalls, but the photographs and the account given in the *Sailplane and Glider* of April show, I think conclusively, that the clouds belonged in general either to the type that has been classed as 'longitudinal' or to the rectangular' type The photograph on p 52 of that issue, which illustrates the 'streets of clouds' utilised by the pilots shows very clearly the spiral form that is characteristic of longitudinal cells it suggests also that the maximum lift would not be immediately under the axis of the spiral

My impression, derived solely from theoretical considerations, is that under such clouds the up currents would not usually be strong, but the formation of soft hail and the shapes in the photographs indicate that on that day the ascent was fairly rapid—in fact, some at least of the clouds were approximating to cumulo nimbus It will be interesting to see whether the development of convection in these types is stronger in summer than in spring

G T. WALKER

Imperial College of Science,
South Kensington, S W 7

Molecular Weights of Celluloses

DURING recent years a good deal of attention has been given to the investigation of the molecular weight of 'native' cellulose, but the results are highly discordant, the values most frequently quoted being those of Mark[1] (about 30,000, on the basis of micell length by X-ray analysis and other data), Stamm[2] (40,000, by sedimentation equilibrium in the ultracentrifuge) and Staudinger[3] (about 120,000 by extrapolation of viscosity vs molecular weight data) The sedimentation equilibrium method is the soundest theoretically, and we have recently demonstrated experimentally[4] that it gives correct molecular weight values for long-chain molecules which, like cellulose, give highly viscous solutions.

In continuation of Stamm s work we have determined the molecular weights (by sedimentation equilibrium in the Svedberg ultracentrifuge) and we find that the specific viscosity increases for a number of celluloses and regenerated celluloses dissolved in cuprammonium solvent Calculating the results in the same manner as Stamm did we obtain apparent molecular weights of the cellulose copper complex ranging from 100 000 to 300 000 depending upon the extent to which degradation had occurred during the previous history of the specimens The 300 000 value was obtained for a portion of cellulose which Stamm studied and for which he reported a value of 55 000 for the cellulose-copper complex We suspect that degradation inadvertently occurred during Stamm s determinations To obtain the molecular weight on a copper free basis Stamm assumed one copper atom combined per glucose group corresponding to a correction factor of 72 per cent and leading to his final value of 40 000 Our results on combined copper and also consideration of the partial specific volume of the copper compound yield a correction factor of 60 per cent so that our cellulose molecular weights range from 60 000 to 180 000 We estimate the molecular weight of native cellulose to be in the neighbourhood of 300 000

The specific viscosity of the cuprammonium solutions of the celluloses increases in a definite manner with the molecular weight so that after empirical calibration of the relationship by ultracentrifugal analysis it is possible to calculate average molecular weights from viscosity data The numerical relationship in the range of molecular weight that we have studied varies appreciably with the composition of the solvent and is not in agreement with the relationship published by Staudinger The application of Staudinger s equation to our viscosity data gives molecular weight values of 20 000 to 90 000 that is from a third to a half as great as the ultracentrifuge values

ELMER O KRAEMER
WILLIAM D LANSING

Experimental Station
E I du Pont de Nemours and Co
Wilmington Delaware
April 26

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[1] H Mark *Trans Faraday Soc* 29 41 1933
[2] A J Stamm, *J Amer Chem Soc* 52, 3047 1930.
[3] H Staudinger *Trans Faraday Soc* 29 18 1933
[4] *J Amer Chem Soc* 55, 4319 1933

Natural Interconversion of Isomeric Sugars

THE mechanism involved in the smooth transformation of one simple sugar into another is a matter of the utmost importance to the chemist and the physiologist alike but little light was thrown upon the subject until Robinson[1] introduced the interesting theory that Walden inversion (conditioned by the enzymatic hydrolysis of phosphoric esters) within the sugar molecule is an agency for such changes This hypothesis presents a simple and rational explanation of the conversion of glucose into galactose by the mammary glands during lactation and lends colour to the suggestion that the primary constituent of nucleic acid is the commonly-occurring xylose which undergoes conversion to ribose in an analogous manner. Mathers and Robertson[2] in a research on the hydrolysis of *p* toluenesulphonyl esters of glucose recently adduced evidence which strongly supported this view in as much as they were able to convert a derivative of glucose into a derivative of altrose in one operation Cognate researches have brought to light the following significant facts

The alkaline hydrolysis of

(1) 2 3 Di *p* toluenesulphonyl 4 6 dimethyl α methylglucoside yields a 2 3-anhydro 4 6 dimethyl α methylhexoside and 4 6-dimethyl α methylaltroside[2]

(2) 2 3 Di-*p* toluenesulphonyl 4 6 benzylidene α methylglucoside yields a 2 3 anhydro 4 6 benzylidene α methylhexoside and a monomethyl 4 : 6 benzylidine α methylhexoside which is not a derivative of glucose or mannose

(3) 2 3 Dimethyl 4 6-di-*p* toluenesulphonyl α methylglucoside yields a complicated mixture containing a derivative of glucoseen

(4) 3 *p* Toluenesulphonyl diacetone glucose gives a quantitative yield of diacetone glucose

(5) 2 3 Dimethyl 4-*p* toluenesulphonyl 6 triphenylmethyl α methylglucoside gives an almost quantitative yield of 2 3 dimethyl 6 triphenylmethyl α methylglucoside

(6) 2 3 6 Trimethyl 4-*p* toluenesulphonyl β methylglucoside gives unchanged material and 2 3 6 trimethyl β methylglucoside

Viewing the results as a whole it is evident that these hydrolytic reactions fall into two main groups which may be characterised as normal and abnormal according as the original substance contains one or two *p* toluenesulphonyl residues in neighbouring positions It is also worthy of note that in the cases where Walden inversion has been proved to occur such inversion is accompanied by anhydro formation This fact at once suggests the idea that anhydro formation may be a necessary precursor to this type of inversion which follows as a consequence of the opening of the anhydro ring Such a hypothesis is in keeping with the main principle of the Robinson conception and at the same time invalidates the criticism levelled against it by Levene[3] whose evidence is based upon the hydrolysis of a phosphoric ester of 5 methyl monacetone xylose in which the possibility of anhydro formation is precluded

A full account of these investigations will be published later and it is hoped that the various extensions of the work which are now on hand will lead to a definite elucidation of this complicated but highly important problem

G J ROBERTSON
J W H OLDHAM

Chemical Research Laboratory
University of St Andrews
April 27

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[1] Robinson, NATURE, 120 44 July 9, 1927
[2] Mathers and Robertson, *J Chem. Soc* 1076 1933 *cf* NATURE, 132, 789 Nov 18, 1933
[3] Levene and Raymond, *J Biol. Chem.* 102, 347 1933.

A New Type of Artificial β Radioactivity

THE energy spectrum of positive electrons from magnesium when bombarded by α particles of radium C reduced in range to 6 3 cm were investigated by a method already described[1] It was found that the number of positives is less than that expected from the measurements of the integral effect Changing the direction of the magnetic field, a great number of negative electrons could be observed The number of negative electrons was about four times as great as the number of positive electrons.

In order to ascertain the true origin of the negative electrons, the following experiments were performed A sheet of tinfoil or paper was exposed to α rays under the same conditions as the magnesium The absence of radioactive impurities was proved by the absence of β particles in these two cases The β particles were also absent when the source was covered by a tinfoil in order to stop the α particles Thus it is evident that the phenomenon is due to the bombardment of α particles

The number of negative electrons quickly diminishes with time (the half period is about 3 min) The limit of the continuous spectrum of the negative electrons is above 2×10^6 e v The probable nuclear reactions in the case of positive and negative electrons may be written in the following way

$$ {}_{12}Mg^{24} + {}_{2}He^{4} \rightarrow {}_{14}Si^{27} + {}_{0}n^{1}, \quad {}_{14}Si^{27} \rightarrow {}_{13}Al^{27} + \epsilon+ $$

(Curie Joliot reaction)

for positives and

$$ (1) \quad {}_{12}Mg^{25} + {}_{2}He^{4} \rightarrow {}_{13}Al^{28} + {}_{1}H^{1}, \quad {}_{13}Al^{28} \rightarrow {}_{14}Si^{28} + \epsilon- $$

or

$$ (2) \quad {}_{12}Mg^{26} + {}_{2}He^{4} \rightarrow {}_{13}Al^{29} + {}_{1}H^{1}, \quad {}_{13}Al^{29} \rightarrow {}_{14}Si^{29} + \epsilon- $$

for negatives In both cases we ought to detect radioactive atoms of aluminium

In the case of aluminium we were also able to obtain the emission of negative electrons, but their number is considerably less than the number of positive electrons

A J ALICHANOW
A J ALICHANIAN
B S DVHELEPOW

Physical Technical Institute
Leningrad
May 13

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[1] Alichanow NATURE 133 581 April 14 1934

Absorption of Hydrogen by Nickel

IN order to measure the adsorption of hydrogen by pure nickel, free from oxygen, I used a silica tube, containing 12 kilometres of a very thin nickel wire (total weight of the wire 42 grams, mean diameter 0 022 mm) giving an available surface of at least 8,400 cm^2 The preliminary results indicate that between 200° and 650° C , and pressures up to 0 2 mm Hg, there is no measurable adsorption of hydrogen, but an appreciable absorption (homogeneous solution) The results are in good agreement with Sieverts' measurements with much thicker nickel wire at higher pressures and temperatures[1] The amount of absorbed hydrogen at a constant temperature is, within the experimental error, proportional to the square root of the pressure, and increases at constant pressure with increasing temperature, obeying the simple equation $\log a = A - B/T$. The heat of absorption, calculated from this isobare, is a little less than -3 k cal per gram mol hydrogen

Further details, together with the results at lower temperatures, which are under investigation, will be published shortly

J SMITTENBERG
(Netherland Ramsay Memorial Fellow)

The University,
Bristol
April 17

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[1] A Sieverts, Z physik. Chem., 60, 129, 1907 A Sieverts and J Hagenacker, Ber, 42, 338 1909 A Sieverts, Z physik Chem. 77, 591 1911

Production of Large Quantities of Heavy Water

FROM the discussion recently held in the Royal Society[1], and from several communications on heavy hydrogen published in NATURE, it is obvious that larger quantities of heavy water are at present much needed for investigations in several branches of physics, chemistry and biology To meet this demand, Imperial Chemical Industries, Ltd , is to undertake commercial production at Billingham[2] It may also be of interest to report in this connexion, that various concentrates of the new water are now produced on a large scale in Norway by Norsk Hydro Elektrisk Kvælstofaktieselskab, Oslo Large quantities of '1 300 water' can be obtained from the above company, and richer concentrates will be available at a later date

This company at its works in Rjukan has one of the largest electrolytic hydrogen plants of the world, with a capacity of about 20,000 m^3 per hour Assuming the efficiency of separation by electrolysis so low as 10 per cent[3], a quantity of about 10 litres of pure' heavy water a day can be produced if the consumption requires

In full agreement with other investigators, it has been found that the efficiency is only slightly affected by the conditions of the electrolysis[1,4] However, certain difficulties arose using sulphuric acid with lead electrodes, due to the formation of porous lead on the cathodes and to the formation of fog The efficiency of separation in both acid and alkaline solution agree fairly well with that found, for example, by Harteck[5] Further details of the experimental results are to be published shortly in the *Zeitschrift für Elektrochemie*

LEIF TRONSTAD

Institute of Inorganic Chemistry,
Norwegian Technical High School,
Trondhjem, Norway
May 4

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[1] *Proc Roy Soc* A 144, 1 1934
[2] NATURE, 133 604, April 21, 1934
[3] Taylor Eyring and Frost, *J Chem Phys* 1, 823 1933
[4] Compare for example, Topley and Eyring NATURE, 133, 292 Feb 24, 1934 Bell and Wolfenden *ibid* p 25
[5] Harteck *Proc Roy Soc* loc. cit and *Proc Phys Soc.*, 46 277 1934

Galvanometer Amplification by Photo-Cell

I NOTE with interest Prof A V Hill's letter in NATURE of May 5, describing the use of a Weston photronic' cell in a differential galvanometer relay It is somewhat surprising that Prof Hill's apparatus gives such a small amplification A Weston cell which has been used in a photo relay in this Laboratory for the last three months has given consistently a current amplification of 200 As we are using the same type of galvanometer as Prof Hill, it would seem that the only reason which can explain his having not obtained more than a twenty fold amplification must be the difference in the optical system

Full details will be found in a Laboratory Note communicated to the *Journal of Scientific Instruments* early in March

V R JONES

Clarendon Laboratory,
University Museum,
Oxford
May 5

A Simple Modification of Morse s Rule

MORSE[1] introduced an empirical rule to the effect that

$$\omega_e r_e^3 \approx 3 \times 10^{-21}\ \text{cm}^2 \qquad (1)$$

where ω_e, r_e, respectively, are the equilibrium nuclear vibration frequency (in cm^{-1}) and the equilibrium nuclear separation (in cm) of a diatomic molecule, as deduced from spectra In a recent paper[2], dealing with the classification of non hydride diatomic molecules into groups and periods I have emphasised the importance of the group number n equal to the number of shared electrons or total number of valency electrons of the two separate atoms The way in which the errors from the strict requirements of Morse s rule distribute themselves in certain periods suggests that the insertion of some function of the group number into the Morse expression might lead to better agreement with observation For non hydride diatomic molecules of the period containing two completed K rings associated with each nucleus I have derived the following empirical modification of Morse s relationship

$$\omega_e r_e^3 \sqrt{n} = 9\ 55 \quad 10^{-21}\ \text{cm}^2 \qquad (2)$$

The mean error in deduction of r_e from ω_e values for 29 test cases of electronic levels of diatomic molecules of the specified kind amounts to ± 1 3 per cent from experimental values whilst the mean error using the unmodified Morse expression for the same cases is ± 5 2 per cent The results will be communicated in due course in another place

C H DOUGLAS CLARK

Department of Inorganic Chemistry
University
Leeds
May 4

[1] P M Morse, *Phys Rev* (ii) **34**, 57 64 1929
[2] C H Douglas Clark *Proc Leeds Phil Soc* **2** 502 512 1934

Inheritance in Fresh-water Ostracods

PROF MACBRIDE s recent article in NATURE[1] on Inheritance of Acquired Habits leads me to direct attention to some interesting information which is available from the study of fresh water ostracods

Fresh water ostracods possess both relatively and absolutely the largest sperms known throughout the animal kingdom while quite recently it has been discovered that these enormous sperms are highly motile The sperms are passed into the spermatheca of the female which possesses a spermathecal duct highly complicated in structure and also exceptionally long Under the proper conditions, the large sperms can be seen moving very actively both in the spermatheca and also in the upper or proximal region of the duct The fresh water ostracods are also remarkable for the wide prevalence of parthenogenesis In some cases, whole genera exist in which males are unknown One of the best known genera in this connexion is that of *Herpetocypris* containing the well known species *H reptans* which abounds practically in every pond in the British Isles and is distributed throughout Europe

The genus is a well-defined one, and two years ago taking the genus as described by Sars in Crustacea of Norway" (vol 9), I estimated that there were some twelve species occurring throughout the world, and in no case were the males known The most remarkable fact remains however, that the spermatheca and in particular the spermathecal duct, remains in *H reptans* and in all other species examined nor does it show the slightest sign of degeneration It is not proposed to give here further taxonomic details but anyone familiar with the taxonomy of fresh water ostracods will know many parallel instances

It is fairly obvious that at one time the males must have existed in each species of *Herpetocypris*, and since the males have disappeared entirely from the genus exclusive parthenogenetic reproduction must have been going on for a considerable length of time most probably for thousands if not millions of generations yet this useless spermathecal duct remains

If we treat the matter from a genetical point of view there is a fairly simple explanation but it seems to me extremely difficult to account for the persistence of this highly complicated genital organ if we accept the theory of the Inheritance of Acquired Habit Moreover the case becomes all the more striking when we consider other groups of animals in which parthenogenesis occurs For here it is almost universally true that individuals reproducing solely by parthenogenesis usually have their genital organs impaired in some way

A G LOWNDES

Marlborough College

[1] NATURE 133 598 April 21 1934

MR LOWNDES has misunderstood my article Its purpose was not to put forward a *theory* of the heritability of acquired habit but to show that this heritability has been experimentally *proved to be a fact* If this is so it is possible to explain all cases where the course of evolution has been followed in detail as well as to explain the recapitulatory element in development

E W MACBRIDE

Imperial College of Science
London S W 7

Parasitism in Heavy Water of Low Concentration

THE first biological experiments[1] with heavy water (May 1933) showed that a low concentration of diplogen (1 part in 2 000) may have a beneficial effect on forms such as *Spirogyra* (the average longevity of 355 cells in filament sections of 10 50 cells in the diplogen water was 7 6 days, and the average for 322 cells in ordinary water was 1 6 days) It was also reported[2] that cell division in *Euglena* is increased in this dilute heavy water (density 1 00006) Meyer[3] confirmed the dilute heavy water effect by demonstrating that mats of *Aspergillus* showed sixteen times the dry weight of controls

We have found that flatworms (*Planaria maculata* and *Phagocata gracilis*) kept in dilute heavy water *for long periods show a striking difference* in the rate of shrinkage in body size After four months, the animals in ordinary water were only one fifth the length of the specimens in the diplogen water This was probably due to reduced enzymic hydrolysis in the starving animals since we have shown[4] that the dilute heavy water reduces the activity of amylase and zymin (the enzyme and substrate were incubated separately in the water and no effect was obtained if the substrate only was incubated or if both were allowed to react immediately) The experiment was repeated in more concentrated heavy water (1 213 diplogen ratio) and a new effect appeared The *Planaria* in heavy water of this concentration were rapidly parasitised by moulds and succumbed within three weeks (Fig 1) In some cases the living animal becomes invested with slime mould and in others is covered with tufts of mycelium The reduced metabolism and movement are possible factors in addition to the specific effect of this concentration of diplogen on mould growth

A similar increase in the growth of moulds was seen in tests of *Aquilegia* seeds kindly supplied by the Cambridge Seed Testing Station through the courtesy of Mr Hugh Richardson of Wheelbirks Northumberland In the 0 47 per cent diplogen cultures masses of white mould mycelium appeared (Fig 1) but these were chiefly saprophytic since they occurred mostly on the unsprouted seeds

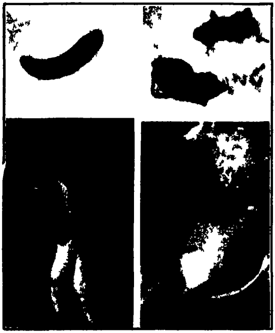

Fig 1 Upper left a control planarian in ordinary water Upper right two representative planarians killed by mould in 0 47 per cent heavy water Lower left sprouting *Aquilegia* seeds in ordinary water Lower right seedling in 0 47 per cent heavy water surrounded by white mould

It would appear from the work of Meyer on *Aspergillus* and the experiments reported in this note that diplogen in 1 200 concentrations has a specific effect in stimulating the growth of moulds and possibly bacteria This property should afford many interesting problems in parasitology and might be of considerable importance in the possible therapeutic use of dilute heavy water

E J Larson
T Cunliffe Barnes

Osborn Zoological Laboratory
Yale University
May 8

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[1] T C Barnes, *J Amer Chem Soc* 55 4332 1933

[2] T C Barnes *Science* 79 370 1934

[3] S L. Meyer *Science* 79 210 1934

[4] T C. Barnes and E J Larson *J Amer Chem Soc* 55, 5059 1933.

Physiology of Deep Diving in the Whale

Prof Krogh in discussing the liability of whales to caisson disease[1] writes Supposing the whale to stay 5 minutes at 100 m the 1 000 litres of blood passing per minute would take up an extra amount of 100 litres and apparently calculates that diffusion would take place as readily at 100 m depth as at the surface of the sea I venture to think that he has overlooked an important consideration

Prof Krogh assumes and I think everyone who has considered the matter will agree with him that the air in the whale s lungs must stand at the same pressure as the water outside the thorax At 100 m the total pressure is about 11 atmospheres absolute so at that depth the whale s lung is compressed until an average alveolus has only one eleventh of the volum it had when the whale left the surface and began to dive This shrinking of the alveol must greatly decrease the surface available for diffusion and in addition the epithelium of the alveolus must become thicker still further hindering diffusion The effect of these changes is to obstruct the entrance of excess nitrogen into the blood when the whale is at a considerable depth and to favour its discharge when the animal is breathing at the surface

G C C Damant

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[1] Nature 133 636 April 28 1934

THE point raised by Capt Damant is certainly important I have not found it possible to conjure up a mental picture of the whale s thorax and lungs compressed to one tenth or less and it becomes especially difficult when the air passages are taken into account since these must take up an increasing proportion of the total quantity of air available If the compression fails to interfere with the circulation I do not think that the diffusion of nitrogen or oxygen will be *very* seriously impaired M Krogh found that the diffusion in human lungs became independent of the volume when this was diminished below a certain point and explained this by the folding of the alveolar walls Such folding must take place to a very large extent in the lungs of the diving whale

August Krogh

Copenhagen

J Physiol 49 1915

The Giorgi System of Units

I REGRET to say my recent article on the Giorgi system[1] contained a mistake inexcusable I fear in the case of a pupil of Maxwell In the evaluation of K_0 I used electromagnetic instead of electrostatic units The value I gave needs dividing by v^2 the square of the velocity of wave propagation If we take 3×10^{10} cm per sec as the value of v then K_0 becomes

$$\frac{1}{4\pi}\,\frac{10^{11}}{9 \times 10^{20}} \text{ or } \frac{1}{36\pi}\,10^{-9}$$

and this is the value used by Prof Giorgi

I have to thank more than one correspondent for the correction

R T Glazebrook

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[1] Nature 133, 597 April 21 1934

Research Items

Ancestor Worship in Portuguese East Africa. An account of a village temple and ceremonial of WaBarwe ancestor worship by the Rev D Shropshire appeared in *Man* for May The temple was situated in a banana grove which was entered through a door way in a decorated bamboo screen It consisted of a small house, 7 ft by 5 ft , with a gabled thatched roof It was built of poles and reeds and had a small wicket gate of reeds Within the temple were two clay pots sunk in the ground A large banana leaf lay on the ground in front of them, and two small pieces of bamboo and a calabash hung from the roof An empty calabash upside down was inserted in the ground One of the pots was for offerings to the mothers of the forefathers of the head of the village, the other for the mother of his father In the ritual of worship the head of the village (or in this instance his deputy) swept the floor of the temple and its precincts He then placed a reed mat in front of the door of the temple and a new large clean banana leaf inside the temple in front of the two pots At a house in the village a procession was then formed which made its way to the temple, the wife of the representative of the village headman carrying mealie meal on a wooden plate On arriving at the temple all knelt and clapped hands ceremonially in greeting to the ancestors The deputy then entered the temple and sat on the ground After further clapping of hands he made offerings of the meal, with an invocation to each of the pots in turn The procession then returned to the house from which it started At the time of the great offering and worship of the ancestors at the sowing season, they offer beer, bananas and rice in addition to the mealie meal They do not pray to the Supreme Being except when out hunting, in prolonged drought or when the medicine man has failed to make a person well He is too far away, and on ordinary occasions they pray to the ancestors to intercede with him, instead of addressing him directly themselves

Tutelary Deities in Lower Bengal A village shrine sacred to two sister deities in a paddy field near Gangājaorā in the neighbourhood of Calcutta has recently been described by Dr Sunder Lal Hora (*J and Proc Asiat Soc Bengal*, N S 29, No 1) The two deities were installed in a small hut built on a low mud platform like a Mohammedan tomb They were represented by beautiful clay figures, dressed in fine and gorgeously coloured clothes The right arm of each was upraised in the attitude of benediction Nearby and on the platform were scattered earthen lamps and shells of coco nuts showing that some sort of *pūjā* had recently been performed there Inquiry elicited the information that the deities were worshipped on a day convenient to the whole village in the Hindu month of *Māgh* (January–February) They are known as *Olā*, *Jholā* and *Bŏn Bibi* *Olā* and *Jholā* are believed to be sisters, the former presiding over cholera, the latter over smallpox Their worship secures immunity for the village from these diseases *Bŏn Bibi* (lit the goddess of jungles) is worshipped to secure protection from jungle beasts The *pūjā* is a common affair for the whole village and the necessary articles are purchased from a common fund to which all contribute according to their means The principal item is the goat for sacrifice When it is beheaded, the head is taken as his fee by the blacksmith who performs the killing, while the remainder of the meat is distributed among the villagers The plot of land on which the *pūjā* is performed has been made over to the village in perpetuity by some rich villager The social status of the Pod caste, to which the villagers belong, is so low that high class Brahmans will not take food or water from the Brahmans who act as their priests An appended note by Dr S K. Chatterji adds that in Bengal, Hindu and Moslem frequently unite in worship of the cholera deity, when she is known as *Bŏn Bibi* as a concession to Moslem feeling

Parasitic Worms of Marine Fishes The attention of zoologists interested in the collection and determination of the parasitic worms of the marine fishes, and also of the marine birds and mammals, found in the British area, is directed to a recently issued section (Lief No 24, 1933) of Die Tierwelt der Nord und Ostsee" (Leipzig Akademische Verlagsgesellschaft m b H) which contains the parts of this work dealing with the Trematoda and the Acanthocephala The part on the Trematoda, by C Sprehn, includes useful tables for the discrimination of the 46 genera of Monogenea and of the 144 genera of Digenea which have been recorded from marine hosts taken in the area of the North Sea and the Baltic A total of 374 species is recorded and the host of each is stated The part on the Acanthocephala by D Wulker and J H Schuurmans Stekhoven, Jr , opens with an admirable summary, in about thirty pages, of the anatomy, life history and ecology of the group Lists follow of the invertebrate and vertebrate hosts of the worms, and keys are provided for aiding the determination of the orders families, genera and species The characters of the fourteen genera and 29 species recorded from the area are concisely stated. This part includes 54 illustrations , there are 20 in the part on the Trematoda

Hawaiian Cypræacea Dr F A Schilder in his paper Cypræacea from Hawaii" (*Bernice P Bishop Museum, Occasional Papers*, 10, No 3, 1933) investigates a large collection of 594 specimens and 19 species collected from Pearl and Hermes Reef, Laysan Island and French Frigates Shoal, Hawaii Most of them are well known shells but they are interesting as they show an extension in range of distribution, and the large number of individuals of many species makes possible the investigation of local variability by statistical methods The distribution of the Eratoidæ (Triviinæ) does not indicate any peculiarity With regard to the Cypræidæ, however, it is evident that the relatively large or callous species have been collected chiefly in French Frigates Shoal and in Laysan Island, whereas the smaller, less callous, or finely sculptured species occur chiefly in Pearl and Hermes Reef The difference, which is striking, indicates ecological differences in these islands. *Lyncina sulcidentata* seems to live equally well in both environments. There is no difference in the shells from Pearl and Hermes Reef All Eratoidæ are relatively small The Cypræidæ from Pearl and Hermes Reef are of medium size to small, or if larger they are always surpassed in size by those from French Frigates Shoal and from Laysan Island, where most species become large to gigantic

American Foraminifera Dr Thomas Wayland Vaughan completes the description of the species of the genus *Lepidocyclina* that have come into his hands during a number of years, thereby aiding in the solution of problems of geological correlation in the Mexican Gulf and Caribbean region in Studies of American Species of Foraminifera of the Genus *Lepidocyclina* ' (Smithsonian Miscellaneous Collections, 89 No 10 1933) The large and valuable material much of which was collected by the author himself from Mexico and Antigua helped by many others, and the collections from Cuba contain numerous species, and the account of them is practically complete These are from the Eocene, Oligocene and Antiguan formation *Lepidocyclina* is found to vary enormously and the difficulty of defining certain species is great The variations are of two kinds, first the difference due to alternation of microspheric and megalospheric generations, secondly the difference due to relative age Because of this large variation it is shown that many so called species are invalid This paper, which is a very valuable one, is illustrated by 32 photographic plates In the same periodical (Smithsonian Miscellaneous Collections, 89, No 11, 1933) Mr Donald Winchester Gravell describes some of the Tertiary larger Foraminifera of Venezuela

Evolutionary and Mutative Degeneration of Eyes in Gammarids Recently obtained results on the normal and mutant eyes of *Gammarus chevreuxi* (cf Wolsky and Huxley, *Proc Roy Soc London*, B, 114 , 1934 , see also NATURE, February 13 1932) make it possible to compare the mutative degeneration of eyes with the evolutionary process of eye degeneration in Gammarids This has been attempted by A Wolsky in a paper published in Hungarian (*Math Termt Ért Budapest*, 51 , 1934), which also gives a description of the loss of eyes in *Niphargus aggtelekiensis*, a recently discovered cave gammarid from the Aggtelek cave in northern Hungary The findings on this species confirm the general view held by various authors (Schneider, Vejdovsky, Strauss), that the evolutionary process of eye degeneration in Gammarids shows a centripetal tendency That is to say, the superficial elements of the eyes (crystalline cones) are affected first, and from these the degeneration proceeds towards deeper regions, finally affecting the optic nerve In *Niphargus aggtelekiensis* the eyes are entirely obliterated, but traces of the optic nerve are still present, although much reduced, and probably fused with elements of another nerve On the other hand, the eye reduction of *Gammarus chevreuxi* mutants (albino type) must be considered as centrifugal, because the elements affected most are the deeper ones (retinula, optic nerve and optic tract), whereas the crystalline cones, although highly degenerated are still present The embryological results confirm this, and indicate that in ontogeny degeneration starts at the junction between the base of the eye and the brain, and proceeds in both directions from this centre Thus the comparison does not support the view put forward by various authors (Banta, Nachtsheim), that blind cave species might have arisen from mutants with reduced eyes The mutations involved in evolutionary eye reduction must have been of other types than those which occur under laboratory conditions

Transmission of Streak Virus by a Leafhopper. At the East African Agricultural Research Station, Amani Dr H H Storey has shown that the leafhopper *Cicadulina mbila*, transmits the virus of streak disease from plant to plant of maize He has since found (*Proc Roy Soc* , B, 112, 46) that this vector capacity of the species is hereditary and that certain individuals do not possess it The hoppers when hatched are always non viruliferous and some of them are incapable of natural infection Pure lines of active and inactive insects were bred and crossed, the results of reciprocal crosses showing that the vector ability is inherited as a simple dominant sex linked Mendelian factor No difference could be found in the mouth parts of the two types In a further investigation (*Proc Roy Soc* , B, 113, 463) Dr Storey finds that after feeding on an infected plant the virus is present in the intestine but soon disappears from the rectal contents after they are voided In the 'active insect the virus can also be detected in the blood whereas in an 'inactive insect it is confined to the intestine The intestine wall of the latter therefore resists the passage of the virus but this may be overcome by puncturing the abdomen with a fine glass needle Some secondary mechanism must also be present since the frequency of success with this method is higher in active than in inactive insects An insect once infective remains so throughout its life In another species, *C zeæ* the inactive races were shown to be susceptible to inoculation by the same method

Fusarium Wilt of Asters A disease of China asters, which gives symptoms very similar to those of foot rot' or 'black leg , has been found in England by Messrs L Ogilvie and B O Mulligan (*Gardeners' Chronicle*, March 31, 1934 p 215) The causal fungus of foot rot was not present, and it was ultimately found that the asters were attacked by the fungus *Fusarium conglutinans* Two strains of the parasite were found—var *callistephi*, and var *majus* Symptoms are most conspicuous when the plants form their first flower buds Black areas extend from the base of the stem to the flower stalks, whilst the leaves turn yellow The plant ultimately wilts Trials with a large number of aster varieties have shown that English varieties are almost all susceptible, but an imposing list of American varieties which are resistant in Great Britain is given The disease appears to be the same as that known in the United States and in various European countries

Fungi Destroying Leather. The condition known to the leather trade as 'red heat' may cause loss to salted hides by producing thin spots of weak texture A study of the bacteria which cause this disease in Canada has been made by A G Lochhead (Bacterial Studies on the Red Discolouration of Salted Hides", *Canadian J Res* , 10, No 3, pp 275-286, March 1934) Two organisms were isolated—one was similar to *Serratia salinaria*, which causes reddening of cured codfish in eastern Canada, and the other was apparently a new species, named *S cutirubra* Both organisms can live on substrate containing relatively large quantities of salt, and are proteolytic They are considered to cause more damage than a species of red halophilic sarcinæ which was isolated from

Argentine hide. Non-chromogenic bacteria were also isolated from salted hide, but seem to be less injurious than those which produce the red colour.

Submarine Valleys. The submarine valleys of continental margins have generally been explained as having originated during a period of emergence and having retained their form for one reason or another during subsequent submergence. This origin, at least in relation to the submarine valleys of the coast of southern California, is questioned by the late Prof. W. M. Davis in the *Geographical Review* for April. Several of these valleys are continued to depths of 200–300 fathoms, which is considerably lower than Daly's estimate of the glacial lowering of sea level. Nor is there any evidence of upheaval or subsidence by that measure of height. Further, ordinary depositional processes which are building up the shallow sea floor ought to have obliterated at least the inner part of these valleys, but the reverse is true: some process is keeping these valleys open. Prof. Davis termed these valleys submarine mock valleys, since he does not believe they are due to subaerial erosion. He throws out the suggestion that the real explanation lies in a slow process of submarine erosion in rock disintegrated by a sea-floor current due to some peculiarity of coastal configuration and accelerated no doubt during stormy weather. This submarine erosion or marosion, as Prof. Davis termed it, might create a valley in the course of time and meanwhile of course no sedimentation would occur in it but only on either side. Monterey mock valley, seventy miles south of the Golden Gate, is cited as a typical example.

Architectural Acoustics. The issue of the *Journal of the Franklin Institute* for April contains the address delivered before the Institute in December by Dr. Paul E. Sabine on recent developments in architectural acoustics. Since Prof. Wallace Sabine of Harvard, the founder of the subject, gave an address on it nineteen years ago, great improvements have taken place in both the production and the measurement of the intensity of sounds of all audible frequencies, mainly due to the vacuum tube and amplifier, and we now know that the response of the ear to a sound is proportional to the logarithm of the intensity of the sound. So far as sound insulation is concerned, it is now established that materials like felt reduce the sound transmitted through them to a much smaller extent than solid walls, 4 in. of felt giving less reduction than one inch of solid plaster. The transmission through walls and partitions depends on their forced vibrations, and the sound reduction produced by them is very nearly proportional to the cube of the weight per square foot of wall. In the case of double walls or partitions, structural connexion between the two should be avoided and one of them should be of the heavy and the other of the light type.

Isotopic Separation by Electrolysis of Water. It is known that the lighter hydrogen isotope is evolved preferentially when an alkaline solution is electrolysed, and Polanyi has concluded that this is due to a difference of overpotential for the deposition of H^1 and H^2 on the cathode. R. H. Fowler (*Proc. Roy. Soc.*, A, April) has examined alternative mechanisms for the preferential evolution. He writes equations for the concentration of hydrogen ions in different parts of the cell in steady electrolysis. The self-diffusion of the water is apparently sufficient to keep the ratio of heavy to light hydrogen normal near the cathode in spite of the different mobilities of the ions. In addition to the mechanism proposed by Polanyi, however, there may be differential rates of molecule formation by combination of atoms at the cathode surface. It may be noted that Polanyi's mechanism is not consonant with Gurney's theory of electrolysis, while the theory is not inconsistent with the alternative explanation.

Crystal Structure of the Heusler Alloys. The Heusler alloys are remarkable in that they become ferromagnetic after suitable heat treatment, although they contain only non-ferromagnetic elements (copper, manganese and aluminium). A. J. Bradley and J. W. Rodgers (*Proc. Roy. Soc.*, A, April) have investigated the alloys by X-ray crystallography in order to find if the ferromagnetic behaviour is correlated with a particular crystal structure. The annealed alloys (non-magnetic) mainly show a structure like that of a γ-brass, but the quenched specimens (magnetic) show a body-centred cubic structure with a face-centred cubic superlattice. The further investigation of this structure was carried out by careful intensity measurements on powder photographs. It was found possible to distinguish the positions of the copper and manganese atoms by observing the powder patterns with iron, copper and zinc *K* radiation, since the scattering power of an atom for X-rays varies rather rapidly in the neighbourhood of an absorption edge. This is a new method which may have important applications. The magnetic alloys have a structure in which copper, manganese and aluminium atoms occupy quite definite positions in the lattice, but when the composition of the alloy differs from Cu_2MnAl the positions normally occupied by atoms of one element may be replaced according to definite rules by those of another, the structure remaining homogeneous.

Lubricating Grease. Choice between grease and oil is a vital problem in industrial plant lubrication to-day and cannot be made without a comprehensive knowledge of physical characteristics and behaviour of the lubricants in question, as well as an understanding of prevailing operating conditions. Much work already done on lubricating oils has led to their several varieties being classified and their characteristics standardised. With greases, however, this is not the case, since until recently they were regarded merely as an outlet for by-products of the petroleum industry and not assessed on their true value as lubricants. H. S. Garlick, in a paper read on May 8 before a meeting of the Institution of Petroleum Technologists, stated that the most convenient method of classification of greases is according to the soap used in their manufacture; thus, the main types are lime, soda, lead and aluminium base greases, with a fifth class of miscellaneous types and special products. In all cases consistency, melting point (flow point), stability both in storage and in use, colour, odour and load-carrying capacity of greases should be determined under known conditions and by accepted methods before application and, in circumstances where the manufacturer or user may require fuller information, exhaustive physical and chemical analyses should be carried out. Unfortunately, research on lubricating greases has not yet reached a point where standard methods of testing can be fixed.

The Royal Observatory, Greenwich

Annual Visitation

THE annual meeting of the Board of Visitors of the Royal Observatory, Greenwich, was held on June 2 The outstanding feature of the report, presented by the Astronomer Royal, Dr H Spencer Jones, is the announcement of the completion and erection of the new 36 in reflector the gift of Mr W Johnston Yapp The new telescope was formally opened by the First Lord of the Admiralty on the afternoon following the Board meeting

On the occasion of the formal opening, Dr Spencer Jones referred to the generosity of the donor, and to the fact of the gift having been made in recognition of the work of his predecessor Sir Frank Dyson The telescope is not, of course, nearly so large as the giant reflectors in use in the United States, but it is as large as might profitably be installed at Greenwich, on the fringe of the great smoke cloud of London As an instance of Dyson's eagerness in following up new avenues of astronomical work, Dr Spencer Jones reminded his hearers that during the darkest hours of the War Sir Frank organised an eclipse expedition in order to make use of the favourable eclipse of 1919 at which the general relativity theory might be tested Despite the short interval which elapsed between the end of the War and the eclipse and despite the great difficulties of the times, an expedition was successfully organised parties being sent from Greenwich and from Cambridge The success of these expeditions in establishing the observational evidence for the general relativity is well known

Sir Frank Dyson who spoke next, paid a tribute to the keenness and enthusiasm of his staff, which he said, had contributed very materially to the progress of the Observatory under his direction The First Lord then formally accepted the gift on behalf of the Admiralty which, he said, is very proud of its connexion with Greenwich

The new telescope is fully described in the May issue of the *Observatory*, and also in the *Engineer* of May 18 and 25 by courtesy of which we are reproducing a general view of the instrument (Fig 1) It may be said here that the great mirror, which was cast by the Parsons Optical Glass Co Derby, is of 36 in aperture and has a focal length of 15 ft The instrument is intended primarily for use in the Cassegrain form and there is a hole 7 in in diameter, in the great mirror The secondary mirrors, of which there are two are made of fused quartz The secondary mirror which is in use at present is convex and has an aperture of 7 in and a focal length of 30 in Set 30 in inside the principal focus of the great mirror it sends a parallel beam on to a slitless spectrograph The alternative secondary mirror is also convex but has a diameter of 11 in and a focus of 75 75 in It will be set 50 in inside the principal focus and will be used to project a real image of a star on to the slit of a slit spectrograph The equivalent focal length of this arrangement is 45 ft

The slitless spectrograph is actually in use It was constructed by Messrs Hilger, Ltd It takes a 6 in parallel beam through a single 45° prism The refracted beam is focused by a 9 in concave mirror of 36 in focus placed about 36 in behind the prism The returning rays are deflected by a flat to a camera at the side of the spectrograph The use of a mirror instead of a lens is designed to give perfect focus over a large range of wave lengths, as the instrument will be used to continue the Greenwich work on colour temperatures of stars The light grasp of the combination of telescope and spectrograph is such that a well exposed spectrogram of a star of magnitude 3 0 is obtained in three minutes The instrument was brought into use on April 20, and the report of the Astronomer Royal mentions that 19 comparisons of 12 stars with standard stars (for colour temperature) have been secured on four nights Attention will be concentrated on stars from types *O* to *A*0 down to the fifth magnitude

The mounting of the telescope is the modified English form A long polar axis is supported by piers resting on very solid concrete foundations at the north and south ends and carries a crosshead to which the telescope is attached The general arrangement resembles the mounting of the 72 in reflector at Victoria B C, but the Greenwich polar axis is so long—21 ft—that the whole telescope can pass under it if desired All the bearings are in ball races and the telescope moves with great ease It can be turned in Right Ascension and Declination by electric motors both quick and slow motions being provided in each co ordinate The telescope proper consists of a heavy casting to which is attached the mirror cell and an open work tube which supports the secondary convex mirror The dome is 24 ft. in diameter and provides ample room in which to work the telescope It is built of a steel frame covered with papier mâché and sheathed with copper The dome is rotated by a continuous cable operated by an electric motor There is a silvering room for the great mirror, which will be carried there on a special trolley

The instrument is by Messrs Grubb, Parsons and Co and the building was erected by the Civil Engineer's Department of the Admiralty A slit spectrograph has been designed for use with the instrument This will have three prisms made of a glass transparent in the ultra violet, but an alternative camera for use with one prism alone will be provided

Turning to other features in the Astronomer Royal's report it is noted that progress has been made with the new transit circle, which is being constructed by Messrs Cooke, Troughton and Simms Ltd The house for this instrument has already been erected This is semi cylindrical in shape, the axis of the cylinder coinciding with that of the transit circle and the interior diameter being 30 ft Two shutters, which are opened by electric motors, give an aperture of 8 ft in the meridian The housing is covered with copper sheeting over a layer of compressed cork slabs, three inches thick, to give thermal insulation

During the past year, meridian observations of the sun were secured on 148 days and of the moon on 100 days The mean correction to the moon's longitude from Brown's tables has decreased still further It is now +4 2″ Two hundred and eighteen plates for latitude variation were taken with the Cookson floating telescope, and 358 observations of 227 double stars were secured with the 28 in equatorial The parallaxes of 32 stars were determined

The work with the 30 in reflector on the colour temperatures of the stars was continued until the Yapp reflector was ready to supersede the older instrument Attention has been concentrated on re determining the zero point of the Greenwich colour temperature system The acetylene burner formerly employed has been replaced by an Osram unifilar tungsten filament vacuum lamp, which was calibrated at the National Physical Laboratory at the beginning and at the end of the programme The combined results of the old and new determinations of colour temperature of standard stars, which agree very well with one another, give a temperature of 18000° K for *A*0 stars

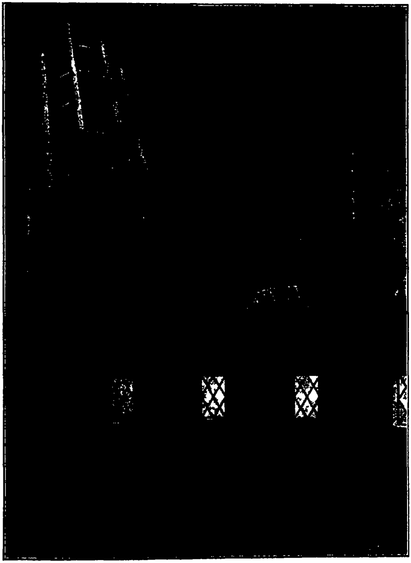

FIG 1 The Yapp 36-in reflector at the Royal Observatory Greenwich

The measurement of plates taken at the 1930–31 opposition of Eros is proceeding Photo heliographs of the sun have been obtained on 271 days, and observations with the spectrohelioscope on 190 days The frequency curves of the Greenwich observations of radial velocities of dark flocculi associated with sunspots have been plotted and are found to be in agreement with the predictions of Chandrasekhar's recent theory of the chromosphere Sunspot activity has been slight The new sunspot cycle however, appears definitely to have commenced Magnetic and meteorological records have been kept, as usual, by the Observatory the former having been secured at the magnetic station at Abinger The mean magnetic elements for 1933 at Abinger were Declination, 11° 51 7 W , Horizontal Force 0 18532, Vertical Force 0 42942 Dip 66° 39 4

As is well known, last year was marked in Great Britain by a great scarcity of rainfall The total rainfall at Greenwich for twelve months ending 1934, April 30, was 16 96 in , which is 7 28 in less than the average for the years 1841–1915 In view of special interest attached to observing conditions in England apropos the advisability or otherwise of erecting large telescopes in Great Britain rather than in South Africa it may be noted that the sky was completely unclouded on 41 nights only in the entire year

Special interest is attached to the time determinations at Greenwich during the past year as an international longitude programme was organised in October November 1933 in which Greenwich took an active part A new type of chronograph with a very light syphon pen and a tape running at 2 5 cm per sec instead of the old fashioned barrel has been installed It is now estimated that the probable error to be attached to each determination of time is 0 010^s but that there are still personal equations to be attached to individual observers in spite of the use of the moving wire micrometer Two of the routine observers differ from one another by 0 04^s At present the mean of three regular observers is taken as standard for Greenwich Mean Time It is hoped to construct a personal equation machine in the future Meanwhile a cathode ray oscillograph has been purchased with which it is intended to investigate time lags in the reception of wireless time signals

R v d R W

Spectroscopically Pure Substances

About ten years ago Messrs Adam Hilger Ltd, the well known firm of optical instrument makers first undertook to place on the market substances of a high degree of purity such as could be relied upon for the exacting requirements of spectroscopic work It was intended that such supplies should not only be the purest obtainable by modern technique but should also be accompanied by a detailed report of the exact amounts of residual impurities as measured by both chemical and spectroscopic methods In some cases indeed so pure have been the products obtained that only quantitative spectroscopic analysis has been available Messrs Hilger have obtained their supplies from specialists in all parts of Europe and the United States and they have been produced in the laboratories of universities technical institutes industrial works and of private individuals as well as from the National Physical Laboratory

Up to 1932 metals alone had been produced but recently oxides and salts have been added to the list Of these highly purified materials some twenty two are metals eleven are rare earths and the remainder are largely commoner salts and oxides The magnitude of this achievement and the considerable advance in the technique of both preparation and analysis made in recent years may perhaps best be judged from the facts relating to a few typical substances

Manganese This metal has been prepared in the National Physical Laboratory according to the formula of Dr M V Gayler A high frequency induction furnace is used to distil the metal at a temperature just above its melting point (1244° ± 3° C) at a pressure of one or two mm Brittle silver grey nuggets obtained in this way were found to have a purity of 99 99 per cent The principle impurities were aluminium (0 0003 per cent) iron (0 0024 per cent) nitrogen (0 0027 per cent) and phosphorus (0 0007 per cent)

Germanium has been prepared in the laboratories of the Sir John Cass Technical Institute of at least 99 98 per cent purity The impurities found were iron (less than 0 001 per cent) and sulphur (0 002 per cent)

Cadmium and Zinc Both of these are of exceptional purity, namely, of more than 99 999 per cent The zinc contains copper (less than 0 0001 per cent) lead (about 0 0002 per cent), and slight traces of calcium and iron The cadmium contains traces of bismuth, lead and copper in each case to an extent of less than one part in a million

Columbium of 99 8 per cent purity has been prepared According to Dr W F Meggers the metal is free from the frequently associated elements vanadium tantalum zirconium and molybdenum and contains as impurity chiefly tin—which is not of great inconvenience from a spectroscopic point of view

Iron rods obtained electrolytically with a purity of 99 96 per cent are available These contain 0 02 per cent of non metals (of no spectroscopic interest) silicon (0 01 per cent) and 0 01 per cent of various metals of which full details are supplied

Silver with a purity of 99 999 per cent is probably one of the purest substances produced It has been freed entirely from copper and contains as residual impurity chiefly calcium

Gallium with a purity of 99 938 per cent which contains only 0 05 per cent of zinc is probably the purest specimen of this element so far produced

Copper rods of 99 964 per cent purity have been obtained Of the impurities oxygen accounts for 0 03 per cent and the remainder is constituted of various metals in very small amounts. Very recently Messrs Hilger have obtained supplies of copper of which the impurities are only about one twentieth those quoted above

We turn now to a few chemical compounds which are made available under the trade name of Specpure substances

Beryllium Oxide and Chloride of 99 99 per cent purity contain only iron (0 005 per cent) with a trace of sodium and a minute trace of magnesium These compounds have been hitherto very rare in a highly purified form

Calcium Chloride is notable for its high general purity of 99 993 per cent and especially for its complete freedom from strontium The latter achievement must be rare if not unique since Hönigschmid's recent atomic weight determination was made on material not quite free from strontium

Similarly chlorides of strontium aluminium and cobalt and also powdered silica all of 99 99 per cent purity can be supplied Lead nitrate with a purity of 99 999 per cent and containing only traces of bismuth copper and antimony is also noteworthy

These illustrations will suffice to show the excellence and range of the materials now available A new standard of purity has been introduced on an extensive scale, and Messrs Adam Hilger deserve the congratulations and thanks of physicists and chemists alike for their enterprise and its well merited success

R C Johnson

Heavy Hydrogen

THE April issue of the *Journal of the American Chemical Society* contains some communications on the subject of heavy hydrogen and heavy water (names used by the authors) H S Taylor and Selwood announce an error in the calibration of apparatus which makes the viscosity previously reported erroneous, the correct value is 12 6 milli poises at 20° The ratio of specific gravities of heavy and light waters at 25° is 1 1079 whilst Lewis and Luten give 1 1056 Pure D_2O apparently readily takes up moisture from the atmosphere The ratio D_2O/H_2O in natural water is about 1 in 5000–6000 in agreement with the mass spectrograph results of Bleakney and Gould

Dole reports that the water formed by the combustion of kerosene benzene and honey was 7 8 and 4 parts per million respectively heavier than ordinary water whilst Washburn and Smith had found that water from the combined hydrogen of a willow tree was 5 to 6 parts per million heavier G N Lewis and Hanson show that the vapour pressures of mixtures of H^1_1 and H^2_1 approximate closely to Raoult s law and the temperature at which freezing begins also proved to be nearly linear with the mole fraction While the solid phase is richer in H^2_1 than the liquid the difference is not great say 0 55 mole fraction for the solid when that of the liquid is 0 50

The same investigators also report measurements of the vapour pressures of pure H^2_1 and mixtures of H^2_1 and H^1_1 in a separate communication The triple point of H^2_1 is 45 40 cm and 18 66° *K* An equation of state for H^2_1 is to be published later When H^2_2O is treated with sodium a considerable amount of H^1_1 is present which came from the sodium Lewis and Schutz have measured the vapour pressures of liquid and solid H^2CN those of liquid H^2CN differ very little from those of H^1CN The freezing point of H^1CN is 259°*K* and of H^2CN 261°*K*

The same experimenters find that the ionisation constant of deutacetic acid in heavy water is less than one third as great as that for ordinary acetic acid in common water which indicates that $(H^2)^+$ is much more firmly held by a pair of electrons of another atom than is a proton

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University and Educational Intelligence

CAMBRIDGE —Mr A J Berry of Downing College has been appointed University lecturer in chemistry and Dr C P Snow of Christ s College University demonstrator in chemistry Mr J A Ramsay of Gonville and Caius College has been appointed University demonstrator in experimental zoology J H Halliday of Downing College and J F Everett of St John s College have been nominated to use the University s table at the Zoological Station at Naples

Applications for the E G Fearnsides scholarship for clinical research on the organic diseases of the nervous system must be sent to the Registrary before June 27

The Master and fellows of Pembroke College announce that the Stokes studentship, of the annual value of £400–450, will shortly become vacant Candidates should send their applications to the Master before June 23 They must have shown capacity for research in mathematical or experimental physics or in subjects cognate thereto such as physical chemistry or the study of physical laws in relation to living matter

OXFORD —In presenting Dr Edwin Powell Hubble of the Mount Wilson Observatory for the honorary degree of D Sc on May 29 the Public Orator Mr C Bailey recalled the fact that Dr Hubble is a former Rhodes scholar at Oxford Referring to the great telescope at Mount Wilson as a structure worthy of giants he directed attention to Dr Hubble s researches on remote nebulæ and made especial mention of his conclusions as to the speed with which they are retiring from our view The Vice Chancellor addressed Dr Hubble as illustrious among the illustrious masters of astronomy and as a revealer by his penetrating sagacity of the secrets of the universe

Mr Battiscombe Gunn curator of the Egyptian Section of the University Museum Philadelphia has been appointed professor of egyptology in the University to hold office from October 1

THE Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 have made the following appointments to senior studentships for 1934 —On the recommendation of the University of Cambridge Mr C H Waddington for research in biology and Dr C B O Mohr for research in physics On the recommendation of the Imperial College of Science London Dr J D Solomon for research in geology On the recommendation of the University of Oxford Mr S G Hooker for research in applied mathematics On the recommendation of the University of Aberdeen Dr D J Bell for research in physiology

UNIVERSITY COLLEGE London continues to attract students from all parts of the world in increasing numbers Its recently issued annual report shows that of 3 121 students enrolled in 1932–33 56 per cent were from homes within 30 miles of the College 24 per cent from elsewhere in the British Isles 9 per cent from the rest of the Empire and 11 per cent from the rest of the world India Ceylon and Burma contributed 169 (including 57 post graduate and research students) China and Japan 24 Palestine 16 four other Asiatic countries 23 Germany 55 (including 12 vacation course students) Scandinavian countries 30 Holland and Belgium 25 Switzerland 23 France 20 Italy 15 thirteen other European countries 60 the United States 45 Canada 15 West Indies 12 Australia and New Zealand 41 (33 postgraduate) South Africa 20 Egypt 19 seven other African countries 16 The total number of postgraduate and research students was 496 being 31 more than in the preceding year The medical student enrolment also showed a notable increase from 200 to 230 The most conspicuous decrease was in the department of fine arts from 299 to 253 chiefly women The enrolment of students for the current session up to January 31 was 3 000 as compared with 2 862 at the corresponding date of 1933 The report refers to the completion of the new accommodation for the reorganised Department of Zoology and Comparative Anatomy which it is claimed is alike in planning and equipment second to none in Great Britain

Science News a Century Ago

H.M.S. *Beagle* enters the Pacific

For about two and a half years, H.M.S. *Beagle* under Capt. FitzRoy had been engaged on the exploration of the eastern shores of South America including Patagonia, the Falkland Islands and Tierra del Fuego, but in June 1834 the ship passed from the Atlantic to the Pacific and started on that part of her voyage which was to carry her to Tahiti, New Zealand, Australia and home by the Cape of Good Hope. Weighing anchor on June 8, the vessel left Port Famine and proceeded down the Magdalen Channel, "that gloomy passage which", says Darwin, "I have before alluded to, as appearing to lead to another and worse world". On the evening of that day the ship anchored at Cape Turn close to Mount Sarmiento the highest peak in Tierra del Fuego and the passage was resumed next day in good weather. By night, however, the western part of the channel had been reached, "but the water was so deep that no anchorage could be found. We were in consequence obliged to stand off and on in this narrow arm of the sea, during a pitch dark night of fourteen hours long". On June 10 Darwin says, "In the morning we made the last of our way into the open Pacific. The western coast generally consists of low, rounded barren hills of granite and greenstone. Sir J. Narborough called one part South Desolation because it is 'so desolate a land to behold', and well indeed might he say so. One sight of such a coast is enough to make a landsman dream for a week about shipwrecks, peril and death, and with this sight we bade farewell for ever to Tierra del Fuego."

Sir James South's Telescope

In his autobiography, Airy records that on June 14, 1834, "I went to London, I believe for the purpose of trying the mounting of South's telescope as it had been strengthened by Mr. Simms by Sheepshanks's suggestions. I was subsequently in correspondence with Sheepshanks on the subject of Arbitration on South's Telescope, and my giving evidence on it. On July 29th, as I was shortly going away, I wrote him a Report on the Telescope to be used in case of my absence. The award, which was given in December, was entirely in favour of Simms." South, who was born in 1785 and died in 1867, was a London surgeon who through his friendship with Joseph Huddart (1741–1816) became an amateur astronomer. His first observatory was in Southwark and his second, built in 1826, on Campden Hill, Kensington, where he had a "princely collection of instruments such as have never yet fallen to the lot of a private individual". His work gained for him the Copley Medal in 1826 and the presidency of the Royal Astronomical Society in 1829. About this time he purchased a 12 in. object glass made by Cauchoix from glass supplied by Guinand, and employed Edward Troughton (1753–1835), then in partnership with William Simms (1793–1860), to construct an equatorial telescope for it. The mounting unfortunately did not prove successful, and after an attempt at arbitration the matter went into the courts and led to "the most remarkable astronomical trial which ever took place in England". South, who was of a very litigious nature, was so embittered by losing the case that he broke up the instrument, placarded the walls of his observatory with an extraordinary bill and sold the debris by auction. Fortunately the object glass was not destroyed. In 1862, South presented it to Trinity College, Dublin, and it was afterwards used by Brünnow and Ball at the Dunsink Observatory.

Thilorier's Experiments on Carbonic Acid

Faraday succeeded in 1823 in liquefying carbonic acid, and in 1834 Thilorier obtained it in the solid form of 'snow'. Thilorier, the details of whose life do not appear to be known, contributed several papers to the Paris Academy of Sciences, one of which was read on June 16, 1834. In a report of this paper the *Athenæum* said: "M. Thilorier presented for inspection a machine for obtaining chemically, and in a short time, a quart of carbonic acid; the memoir presented a variety of experiments upon this almost intangible liquid, since it can only be procured in vessels hermetically sealed. M. Thilorier announces that in gases the pressures at different degrees of temperature do not correspond with the densities, as is generally believed. Liquid carbonic acid, he says, is of all bodies, that which dilates and contracts itself the most under the influence of atmospheric variations in temperature. Its enormous power of dilation points it out as a new principle of movement far more powerful than any hitherto applied. It is also the liquid that produces the greatest depression of temperature. Directing a jet of it on the ball of a thermometer of spirits of wine, it reduced it to 75° below zero, the greatest depression hitherto observed being 68°. M. Thilorier intends to apply this liquid to an air gun."

Societies and Academies

London

Royal Society, May 31. A. F. W. Hughes: Development of blood vessels in the head of the chick. The development of both arteries and veins in the head of the chick from the stage of two days of incubation to that of hatching is described, thus continuing the previous account of Sabin, whose methods have been employed in the present study. The simultaneous study of both arteries and veins has thrown light on the well known fact that one type of vessel tends to accompany the other in adult anatomy. Frequently a nerve also enters into this relationship. Such a complex has been found, in the head of the chick, to develop from a capillary plexus developed along the course of a nerve, out of which both an arterial and a venous channel differentiate. There is evidence that in other vertebrates, and in other regions of the body, similar developmental processes take place. Questions of vascular homology, and current theories on the developmental mechanics of the circulatory system are discussed in the light of the facts which this study discloses. The suitability of the embryonic vascular system as an object of experimental embryological study is stressed. A. Farkas, L. Farkas and J. Yudkin: Decomposition of sodium formate by bacterium coli in the presence of heavy water. The isotopic composition of the hydrogen evolved from mixtures of heavy and ordinary waters with sodium formate by the action of this organism has been analysed. Its composition is defined by the equilibrium $H_2O + HD \rightleftharpoons HOD + H_2$. Since the gas liberated is in equilibrium as defined by the equation

$H_2 + D_2 \rightleftharpoons 2HD$, the generally accepted mode of decomposition of sodium formate by the hydrogen lyase must be wrong and either atoms or radicals must be involved Palladium black behaves in a similar manner The importance of this equilibrium in the preferential liberation of light hydrogen in electrolytic and chemical reactions is emphasised

PARIS

Academy of Sciences, April 9 (*C.R*, 198, 1329–1372) HENRY LE CHATELIER The law of the displacement of chemical equilibrium Reply to M Posthumus CHARLES RICHET The growth in ten years of the towns and peoples of Europe, Asia and America *The rate of increase of the pure white races is only* one fifth to one sixth of the yellow or mixed races *Amongst* the pure white races, the Europeans have the smallest rate of increase CHARLES NICOLLE and MME HÉLÈNE SPARROW The existence of a typhus virus in Tunis rats The character of this virus J HAAG Certain problems of the theory of harmonic functions HENRI DEVAUX and JEAN CAYREL The electrical conductivity of thin sheets of copper sulphide obtained at the surface of copper solutions Copper sulphide films of thickness 100–200 A show metallic and not electrolytic conductivity This conductivity is much less (1/3,000 to 1/6,000), than the conductivity of solid copper sulphide E ČECH The decomposition of a pseudo variety by a closed subensemble B DE KERÉKJÁRTÓ The similitudes of space KASIMIR ZARANKIEWICZ The conformal representation of a doubly connex domain on a circular ring SCIOBERETI The determination of a parabolic orbit by the method of Laplace Leuschner J WINTER The refractive indices of electronic waves MLLE SIMONNE CAILLÈRE The incandescence of certain serpentines after their dehydration V AGAFONOFF and G JOURAVSKY The thermal analysis of soils of Tunis HENRY HUBERT The distributions of air currents in tropical cyclones G PONTIER and R ANTHONY Concerning the morphological evolution of the molars in mastodons of the series of *Tetraboledon angustidens* GEORGES TRUFFAUT and SÉBASTIEN PASTAC The influence on plants of the application of electrical currents by contacts *According to the mode of application*, the growth of plants can be either accelerated or retarded by electric currents LÉON PALFRAY and MLLE ANNE MARIE LEPESQUEUR The constitution of essence of carrot G MALENCON New observations concerning the etiology of *bayoud* MME BARTHÉLEMY and R WOLFF The distribution of calcium and magnesium in the organs of the dog

April 16 (*C R*, 198, 1373–1464) R FOSSE, P E THOMAS and P DE GRAEVE Lævorotatory allantoin Natural or artificial allantoin is a racemic compound The preparation and isolation of the lævorotatory form by the action of allantoinase from soya is described J L WALSH Interpolation by rational functions R MAZET A proposed law for completing the laws of friction A supplementary condition is suggested capable of resolving the indeterminate case known as the Painlevé paradox JEAN LOISEAU The impossibility, in space of three dimensions, of constructing a rational mechanics capable of representing with certainty all observable phenomena JACQUES VALENSI The vortex phenomena below an aerial screw MAX SERRUYS The mechanism of shock in explosion motors Arguments opposed to the peroxide theory as to the cause of knocking E JOUGUET Remarks on the preceding paper EMILE BELOT The pulsation of stars with constant ellipsoidal volume and variable flattening HENRI MINEUR The application of two methods of study of the galactic rotation of the *B* stars A BUHL The extreme indetermination of certain propagations connected with Schrödinger's equation R ZAIKOFF The tensorial form of undulatory mechanics NICOLAS DE KOLOSSOWSKY and W W UDOWENKO The determination of the specific heats of liquids NY TSI ZÉ and TSIEN LING CHAO The development of electricity by torsion in quartz crystals MLLE SUZANNE VEIL Some anodic oxidations in gelatine HUBERT GARRIGUE New results on the green line of the non polar aurora in the night sky JEAN BECQUEREL W J DE HAAS and J VAN DEN HANDEL The paramagnetic rotatory power and the law of magnetisation of tysonite in the direction of the optic axis at very low temperatures RENÉ COUSTAL The action of the silent electric discharge on the phosphorescence of certain alkaline earth sulphides A description of changes in the luminosity of phosphorescent sulphides produced by the silent discharge P SAVEL The complex radiation excited by the α particles in light bodies LOUIS MÉDARD The Raman effect of the hydroxyl radical A Raman band about 3000–3600 cm^{-1} has been observed with water, sulphuric nitric and phosphoric acids, and six alcohols Hence this band is not peculiar to water but is shown by liquids the molecule of which includes the (OH) *group* H SPINDLER *A new* property of substances possessing the structural number 56 J PERREU The thermochemistry of aqueous solutions of the sulphates of zinc, aluminium and manganese PAUL MONDAIN MONVAL The crystallisation of vitreous bodies Study of the metastable crystalline forms of sulphur and selenium PICON The chemical properties of the titanium sulphides HENRI MOUREU and ARMAND MARIE DE FIOQUELMONT A new mode of formation of phosphorus nitride P_3N_5 DESMAROUX The stability of the nitrocelluloses Study of the saponification hydrolysis and combustion in dilute nitric acid D LIBERMANN The supposed triarylorthosulphurous acids of Richter ROGER PERROT The action of nitrosyl chloride on some aromatic hydrocarbons At 150° C, the hydrocarbons studied reacted according to the equation $RH + 2NOCl = 2NO + RCl + HCl$ M LESBRE and MLLE G GLOTZ Some stannonic acids G DARZENS and MACENCE MEYER A new method of synthesis of β-quinoline bases containing alkyl groups in the pyridine ring J A GAUTIER The chloride of α hydroxyphenethylpyridinium and of *N*-α hydroxyphenethyl α pyridone C LEFÈVRE and CH DESGREZ Contribution to the study of the organic sulphides MARCEL MATHIEU Two remarks on the structure of cellulose and its derivatives CONRAD KILIAN Tectonic and volcanic phenomena in the Ajjer (Central Sahara) H VAUTRIN Contribution to the study of the Jurassic series in the Anti Liban chain and more particularly in Hermon (Syria) P MARTY and L GLANGEAUD The Pontian deposits of Bourboule and the age of the Choussy fault DANIEL CHALONGE, F W PAUL GÖTZ and ETIENNE VASSY Simultaneous measurements of the proportion of ozone in the lower layers of the atmosphere at the Jungfraujoch and at Lauterbrunnen. The results given tend to prove that the concentration of ozone increases with the height above the ground **J Rothé** The magnetism of the basalts of Alsace **Georges Dubois and Mme Camille Dubois** The Flandrian fossil forest modifications of the Paris region Results of a pollen analysis of the peat bogs of Bresles and Sacy le Grand (Oise) **Georges Deflandre** A siliceous fossil Foraminifera from the Miocene diatomites of California *Silicotextulina diatomitarum* **Léon Moret** The corroding Algæ of the Cyanophyceæ group New observations made at the Lac de Marinet in the Chambeyron (Basses Alpes) massif **Georges Ungar** The mechanism of production of the sympathetic effect The phenomena of liberation **Maurice Piettre** The trophic activity of the mammary cell in a period of functional repose Besides the functional activity the elaboration of the milk components the mammary cell possesses a more general activity called by the author trophic activity **M and Mme Gilbert S Adair and M and Mme Jean Roche** Researches on the osmotic pressure and the molecular weight of the hæmocyanines **F Trensz** The use of choroidian melanine made soluble in distilled water for the serodiagnosis of paludism **A Besredka and L Gross** The nature of the pathogenic principle contained in neoplasic tumours

GENEVA

Society of Physics and Natural History, February 15 **J Weigle** A new recording microphotometer The author describes a new recording microphotometer based on the amplification of the photoelectric current This allows the use of a galvanometer of reduced sensibility and of relatively short period **J Weigle** The deformation of cubic crystalline lattices **P Rossier** The width of the composite line $H_\epsilon + H$ in the spectrograms of $B0$ and $F0$ stars This line observed with a small spectrograph with objective prism, has the same width for the two spectral types cited provided that the time of exposure corresponds closely to the magnitude of the star considered **P Rossier** The relative widths of the lines of hydrogen and of calcium in the spectrograms of $A0$ and $F0$ stars Although narrower on the spectrograms of $F0$ stars than on those of the $A0$ stars the ratios of the widths of the hydrogen lines are the same for the two spectral types The width of the K line of calcium varies widely **E Frommel and D Zimmet** Volume of the spleen and pitressine

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Forthcoming Events

[Meetings marked with an asterisk are open to the public]

Monday June 11

Victoria Institute at 4 30—Sir Ambrose Fleming Truth (Presidential Address)

Institute of Physics (Manchester Section) at 5—(in the Physics Department The University)—J D Bernal Heavy Hydrogen *

Royal Geographical Society at 8 30—Sir John Cadman Middle East Geography in Relation to Petroleum

Tuesday, June 12

British Science Guild at 4—(in the Lecture Theatre of the Royal Society of Arts)—Annual General Meeting Prof E N da C Andrade: Friction

Wednesday, June 13

Institute of Physics (Manchester Section), at 5—(in the Physics Department The University)—Prof E N da C Andrade Viscosity *

Thursday, June 14

University College London at 3—Sir Flinders Petrie Recent Discoveries at Gaza, Palestine (repeated on June 16 at 3 and June 19 at 5 30) *

Royal Society at 4 30—Discussion on Methods of measuring and Factors determining the Speed of Chemical Reaction to be opened by Prof A V Hill

Chadwick Public Lecture at 5—(at Chelsea Physic Garden Swan Walk Chelsea)—E Augustus Bowles Simples and Herbals *

University College London at 5 30—Prof Ernest Cassirer The Origin of the Modern Concept of Nature in the Philosophical and Scientific Thought of the Renaissance (succeeding lecture on June 19) *

Official Publications Received

GREAT BRITAIN AND IRELAND

Forestry Commission Fourteenth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1933 Pp 41 (London H M Stationery Office) 9*d* net

Kenya Land Commission Report Summary of Conclusions reached by His Majesty s Government (Cmd 4580) Pp 8 (London H M Stationery Office) 2*d* net

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1566 (T 3434) Wind Tunnel Interference on Wings, Bodies and Airscrews By H Glauert Pp iii+75+22 plates (London H M Stationery Office) 4*s* 6*d* net

Armstrong College Newcastle upon Tyne Standing Committee for Research Report Session 1932 1933 Pp 49 (Newcastle upon Tyne)

Papers from the Geological Department Glasgow University Vol 15 (Octavo Papers of 1931 1934) (Glasgow University Publications 31) Pp viii+19 papers Vol 16 (Quarto Papers of 1931–1933) (Glasgow University Publications 32) Pp iv+6 papers (Glasgow Jackson Wylie and Co)

OTHER COUNTRIES

Smithsonian Miscellaneous Collections Vol 89 No 12 Tribal Migrations East of the Mississippi By David I Bushnell Jr (Publication 3237) Pp 9+4 maps Vol 91 No 8 Reports on the Collections obtained by the First Johnson Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—New Polychaetous Annelids By Prof Aaron L Treadwell (Publication 3236.) Pp 9+2 plates (Washington D C Smithsonian Institution)

University of California Publications in American Archaeology and Ethnology Vol 33 No 5 Two Paiute Autobiographies By Julian H Steward Pp 423–438 (Berkeley Calif University of California Press London Cambridge University Press.)

Publications of the Observatory of the University of Michigan Vol 5 No 13 The Masses and Luminosities of Spectroscopic Binaries determined by the Mass Luminosity Relation By R M Petrie Pp 169–176 Vol 5 No 14 Visual Light Curves of Beta Lyrae By Ralph H Curtiss Pp 177 187 Vol 5 No 15 The Orbit of Comet 1933f (Whipple), Second Paper By Allan D Maxwell Pp 189–191 (Ann Arbor, Mich)

Education, India Progress of Education in India 1927–32. By Sir George Anderson (Tenth Quinquennial Review Vol 1) Pp ix+273 (Delhi Manager of Publications)

The Imperial College of Tropical Agriculture Third Annual Report on Cacao Research 1933 Pp 71+3 plates (Trinidad) 5*s*

Union of South Africa Report of the South African Museum for the Year ended 31st December 1933 Pp 17 (Pretoria Government Printer)

Publications of the South African Institute for Medical Research No 31 Immunity in Rous Fowl Sarcoma and its Bearing on the Problem of the Nature of Normal and Cancerous Growth By Dr M J A Des Ligneris Pp 193 No 32 Entomological Studies—Observations on *Anopheles funestus* and *Anopheles gambiae* in the Transvaal By Dr Botha De Meillon Pp 195–248 (Johannesburg.)

Bernice P Bishop Museum Bulletin 108 Jungle Fowls from Pacific Islands. By Stanley C Ball Pp 121+7 plates (Honolulu)

Bulletin of Yale University Supplement Report of the Director of the Peabody Museum Pp 29 (New Haven Conn)

Annals of the Observatory of Lund. Nr 4 Cosmic Ultra radiation in Northern Sweden By Axel Corlin. Pp A118+B80 (Lund)

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Population Problems

THAT population size and composition exert a profound influence on many of the social political and economic problems which beset a nation and that it will be possible to make a fairly accurate forecast of changes in these qualities at different times in the near future though well established is not generally understood Hence addresses such as the recent Huxley Memorial Lecture on the Restrictive Law of Population by Prof Johan Hjort* and publications such as the newly issued broadsheet of P E P on Future British Population † are to be welcomed and commended to the notice of all those who for this reason or that must now in 1934 take account of the warrantable view that in 1976 the population of Great Britain will be less than perhaps far less than 33 million and that in it the children will be outnumbered by the old The voice that then will make itself heard will be that of secure senescence and largely female at that In 1901 there were 12 million children in Great Britain in 1951 there may be just over 6½ million the present number of women of sixty five years of age and over will be doubled during the next fifty years and will increase by 50 per cent within the next seventeen

Times have changed and changed considerably since the publication of the Essay on Population There is no longer any danger of the means of subsistence becoming disproportionate to the number of human individuals dependent on them for thanks to developments in the methods of food production the relation of man to the resources of his environment has been completely reversed We can produce food of the highest quality in quantity far in excess of the needs of the sum total of human individuals at present living on the earth we can force temperature humidity and light into harmony with our various requirements Thanks to chemistry we are becoming more and more freed from our dependence upon animals and plants for commodities that are essential to our well being and furthermore through developments in reproductive physiology we are now able deliberately to control the reproductive rate of a human society

Thus it is that the Malthusian threat of over population has lost much of its force in fact in most European countries, and in the United States of America, already in its place there is an increasing fear that the peoples are failing to maintain themselves numerically In Great Britain the population is already ceasing to increase, and if no further change in the fertility and mortality rates occurs it can be assumed that a stable age composition in the population will ultimately be reached, and that thereafter the population in each subsequent generation will become progressively perhaps even alarmingly, diminished Indeed it may dwindle away in spite of all improvements in personal and public hygiene which tend to reduce mortality All the evidence that is available shows that such speculations as these are entirely warrantable

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* The Restrictive Law of Population By Prof Johan Hjort (Imperial College of Science and Technology Huxley Memorial Lecture, 1934) Pp 46 (London Macmillan and Co Ltd 1934) 1s net

† Future British Population Planning No 27 May 22 1934 (P E P 16 Queen Anne's Gate London S W 1)

It becomes a matter of supreme importance, therefore to those who wish to see the continuance of ourselves as a people, to inquire into the causes of the numerical decline of a population It is necessary to ask and to answer such a simple question as why it is that people have children at all The child, which seems to be regarded as a welcome reinforcement by those who speak in the name of the State, as often as not is looked upon by the parent as an inconvenient burden It seems to be commonly suggested that man and especially the female of the species, exhibits a definite biological urge toward reproduction This may be, but the view has no experimental foundation, and its investigation is complicated by the fact that, in our society at least, the mother enjoys certain economic and social advantages Of all the factors which are recognised as affecting the reproductive rate of a people, it is generally agreed that the one which is mainly responsible for the dwindling of a population is the progressive fall in the average number of children born to each married woman, and it would seem to be established that a people of which the average woman has less than one female offspring is doomed to extinction

It must remain an unanswered question for the moment as to whether or not it matters very much to the world as a whole and to its further evolution that a particular people, through progressively falling fertility, should disappear All that we can do is to search for information into the causes that operate in the production of a dwindling population in order to obtain a knowledge of the factors involved, so that this may be made available for incorporation into any programme relating to population size which may be formulated in the future Manifestly, the problem stated in its simplest terms is that of removing such obstacles to parentage as exist in a particular society

A great many facts relating to the growth of human populations are already in our possession but concerning their explanation there is still much disagreement We know that, in general the reproductive rate in an industrialised community is lower than that in an agricultural that a preponderance of Catholics in a community is commonly associated with a high fertility that the reproductive rates of people living under different social conditions and belonging to different occupational classes differ more or less widely one from the other But to find a satisfying explanation for these facts is not simple If Roman Catholics are remarkable for their high fertility the Jews, who have a sex ethic that is comparable show a low reproductive rate The differential fertility of the different social classes and of the rural community as compared with the urban may be nothing more than evidence that differences in the social environment can yield differences in the expression of certain biological variables

It has not yet been shown that removal of inequalities in the environment would not produce equality in respect of reproductive rate Indeed there are reasons for holding the view that the differential fertility of the social classes is tending to disappear It has been too easily assumed perhaps, that a widespread use of contraceptives is in itself a sufficient explanation of a falling birth rate It is difficult to accept this statement in view of the fact that legalised abortion and active birth control propaganda in the U S S R do not seem to affect the growth of a people eager and able to expand

One thing is certainly true, and that is that a population can only maintain itself if every woman in it bears on the average three children This of course means that whilst many will bear none, others must bear four and five, and the problem facing those who wish to see our population maintain its present level is that of obtaining in the population a sufficient number of more-than three-children families

It may be assumed that in Great Britain, as in other countries, a low fertility is the result of urbanisation In the social structure, with its tradition which appeals to the incentive of private profit, and in which there are great inequalities in respect of wealth, with an improvement in the standard of living of the people, there have come into being many and varied distractions which can be regarded as alternatives to parenthood The political emancipation of women and their desire for economic liberty have resulted in competition between women and men in businesses and professions, and motherhood no longer offers a satisfactory career to great numbers of women The standards of feminine beauty require habits and physical attributes which cannot easily be harmonised with the realities of child bearing and undoubtedly one of the most important factors which tend to cause family limitation has been the conferring of an economic advantage upon persons who exhibit a low reproductive rate There are in Great Britain hundreds of young married couples who are determined not to have children, at least yet awhile for the simple reason that conditions of life being as they are they much prefer to have other things

The economic barriers to fertility can be overcome by such measures as family endowment, which removes the economic inequality between those who have many children and those who have none, by ruralisation, by giving leave on full pay to women in confinement but when these things have been done there still will remain the underlying psychological causes of self imposed sterility In days gone by when distractions were fewer, when children were an asset, when the man with a quiver full was most highly respected, when opportunity was plentiful, there being no reason to doubt that the child would enjoy the same opportunities as did his parents, it mattered not that sexual activity was so commonly followed by reproduction But in these days, it is becoming increasingly common for parentage to cease to be a casual affair and to be a matter of deliberate choice In the future there will be no such thing as an unwanted child The problem, in its ultimate analysis, therefore comes to be that of cultivating the wish to have children, and of creating a type of society in which the child shall have a definite function

If the population of Great Britain dwindles, it will not be because our descendants will be less fecund than were our ancestors, but because they will choose, or will be forced, for economic or other reasons, to limit the number of children entering into an unsatisfactory environment When the world is fit for children to live in, they will be born, whilst things are as they are, it is perfectly reasonable to limit their numbers

Experiment and Theory

Molecular Hydrogen and its Spectrum By Prof Owen Willans Richardson (Yale University Mrs Hepsa Ely Silliman Memorial Lectures) Pp xiv+343 (New Haven, Conn Yale University Press, London Oxford University Press, 1934) 13*s* 6*d* net

ANYONE seriously engaged in the pursuit of scientific knowledge and with a mentality broader than that of the self sufficient 'research worker, will at one time or another have been confronted with the question as to the importance of his own investigations Aside from the viewpoint *sub specie aeternitatis*, from which the playing of the child in the sand and the discovery of the laws of the physical world appear equally important —or unimportant if one prefers—this question will by everyone be admitted to be entirely justified An answer may perhaps be given in somewhat the following way the more radical the change in our theoretical notions which an experiment necessitates, the more important the experiment, the larger the group of hitherto unexplained facts to which a theory opens an interpretation, the more important the theory In these times, when new scientific views penetrate quickly, the frequency with which a scientific publication is quoted by investigators (other than its author) may serve as a quantitative measure of this importance

Looking at the modern scientific output, one must confess that a good deal of experimental work done to day is bound to fall into oblivion rather quickly But while this work still represents a certain amount of conscientious labour and there is, as with a defaulted bond issue, always still a chance that it may become of value there is no such excuse for the airy castles of speculation of those who forget that the mathematics of the theoretical physicist is a necessary evil and that an accumulation of equations without a physical idea, related in a recognisable way to the empirical reality, does not deserve to be called a theory

Prof Richardson is one of the enviable persons who have been able to combine experimental research with theoretical investigation, and through this fortunate circumstance to advance physical science in very diverse directions The present book, devoted exclusively to the hydrogen molecule and its spectrum, and to a large extent a summary of his own work, illustrates clearly the interaction between experiment and theory Here is a mass of experimental facts, a spectrum of so involved an aspect that for a long time it was neither classified as a line spectrum nor as a band spectrum, but put into a category all by itself under the name of many lined spectrum Only on the basis of the firm belief that the interpretation of the evidence from so simple an atomic system as H_2 must in the end appear simple itself could give the courage to tackle the analysis of the spectrum in question This conviction has been fully rewarded, and indeed, the complete understanding of the structure of this simplest of molecules thus obtained has been material in the elucidation of a number of other problems that had long been puzzling to the physicist

In the earlier chapters of the book the reader is made acquainted with the various quantum numbers and symmetry properties that serve to classify the stationary states of a diatomic molecule Then the selection and intensity rules are discussed, which determine so markedly the character of a band spectrum Regarding the application of the theory to the experimental facts as carried out principally by Richardson and his pupils, by Dieke and by Weizel, it should be stressed that we owe to Prof Richardson the clear recognition of the two non intercombining term systems of H_2 as singlet and triplet-systems as well as a trustworthy spectroscopic determination of the dissociation energy of the H_2 molecule in its ground state, a quantity of great interest both to the physicist and to the chemist, the value of which had been oscillating for a number of years between rather wide limits Also the term system of H_2, besides that of He_2, furnishes an interesting illustration of the phenomenon of *L* uncoupling

The determination of the electronic levels of H_2 was of great importance in connexion with the theory of chemical binding which Heitler and London originally developed for this molecule, and led Hund to a complete level diagram connecting the atomic and molecular states of hydrogen The analysis of the H_2 spectrum was also essential in the discussion of the intensity alternation as observed in many H_2 bands In conjunction with the quantitative intensity measurements of Ornstein and his students it enabled us to ascribe to the H nucleus a spin of $\frac{1}{2}$ and to make sure that it obeys the Dirac Fermi statistics This latter result, together with the explicit knowledge of the rotational levels of H_2 as gained from analysis of the spectrum, again made acute the problem of interpreting the behaviour of the specific heat of hydrogen at low temperatures After Dennison had shown that this behaviour can be explained by considering the gas as a mixture of molecules in even and odd rotational states, which in general will not be in thermodynamic equilibrium, it was only a short time before other workers demonstrated this experimentally by separating the two components, para and orthohydrogen

The book under review is a monument to the co-operation between theory and experiment All physicists will be obliged to its author and to the Silliman Foundation for making the results of researches scattered in many different publications available in this compact and well produced book

R DE L KRONIG

The Thermionic Tube

(1) *Theory of Thermionic Vacuum Tubes Fundamentals, Amplifiers, Detectors* By Prof E Leon Chaffee (Electrical Engineering Texts) Pp xxiii+652+6 plates (New York McGraw Hill Book Co, Inc, London McGraw Hill Publishing Co Ltd, 1933) 36*s* net

(2) *Electron Tubes and their Application* By Prof John H Morecroft Pp xiii+458 (New York John Wiley and Sons Inc, London Chapman and Hall, Ltd, 1933) 28*s* net

(3) *Lehrbuch der Elektronen Rohren und ihrer technischen Anwendungen* Von Prof Dr H Barkhausen Band 2 *Verstarker* Vierte, vollstandig umgearbeitete Auflage Pp xvi+289 (Leipzig S Hirzel, 1933) 7 50 gold marks

(1) THE author warns us that this imposing volume is, 'according to present plans", the first of two, the second, to deal with power amplifiers and oscillators, gas content tubes rectifiers &c', can scarcely fail to reach a comparable size This probable development to some thirteen hundred pages is not an exaggerated measure of the progress made in the theory and practice of thermionic tube technique since 1920, when the classical volume of van der Bijl could be compressed into 390 open pages Van der Bijl's book was then unique, invaluable, indispensable, Chaffee's present work is its natural and worthy successor It contains nearly everything, within the limits indicated, that even the specialist is likely to require as a basis for his own work, and its list of references confirms the impression of encyclopædic completeness But ought it not to be labelled vol 1?

The book opens a little weakly, but gathers firmness of touch as it develops The introductory chapter, and the four-and a-half forbidding pages of symbols which precede it, have a flavour of pedantry and over elaboration which does less than justice to the author's handling of his main material The second chapter is also disappointing the rudiments of atomic theory are treated at unnecessary length, while Planck s constant suddenly appears, with no introduction at all several pages before it is equally summarily dismissed in three inadequate lines

At this point, however, the author reaches the real business in hand, and the temporary reversion to laborious systematisation in a brief chapter on nomenclature and letter symbols has no permanent ill effect Incidentally, however, this chapter itself indicates the solution for the admitted difficulties of symbolisation, for it shows how easily the inconvenient and inconveniently situated list of symbols, already mentioned, could have been compressed into a single page on a final throw out' sheet to unfold clear of the text or, less satisfactorily inserted in an end pocket The change would afford an opportunity for inserting some missing symbols The task of many readers might too, have been lightened by the freer use of a device, adopted in places by the author, of marking with an asterisk matter which may be omitted at a first general reading

Minor defects are not difficult to find but they are rare in proportion to the monumental scope of the treatise, and such as have been discovered will do no harm to any reader capable of using the book as it deserves to be used That Eccles should not be named or credited with the invention of the extremely convenient and now universal nomenclature of "diode, triode pentode ' (which the author uses throughout) might be excused were Richardson not, rather unnecessarily, mentioned as inventor of the substantive "thermion" (which the author immediately rejects) There is no mention of Round s signal service in bringing to practical application the screen grid tube, which Hull and Williams, in the paper cited by the author (and to which he gives considerable and deserved credit) left with the disclaimer "It will be understood that the purpose of this paper is scientific, and bears no relation to commercial development Tubes of the type described are not being manufactured, nor is their immediate production contemplated, so far as the authors are aware " Round's work in this connexion gives him a less qualified claim to a place in the name index than the one actually admitted

No serious reader will believe the author when he seems to assert that amplifiers and relays are one and the same kind of thing or when he seems to say that a modulator tube should be identical with an oscillator tube, or when he seems to say that slow electrons are less easily deflected by a magnetic field than are fast electrons Nor will Brucke ' for Brüche ' break down the bridge between the reader and the original paper on Experimente zu Stormers Polarlichttheorie" More serious than any of these lapses, perhaps, is the failure to quote, in the appropriate place on page 398, the important device of adding decoupling resistances to battery circuits common to several stages of an amplifier This process, which some of us in affectionate gratitude call 'Ferranti-ising avoids the difficulty, which affects also the circumstances discussed on page 456, of providing condensers of sufficiently low impedance at low frequencies to make an effective shunt across such low resistances as are presented by accumulators and filaments

There is evidence of the inclusion of much original work in addition to the systematic retreatment of the work of others The discussion of the overall characteristics and behaviour of the complete system of tube and associated circuits including the very important problems of input and output impedance and of equivalent circuits, deserves special mention The book is very complete and it has no present rival

(2) Prof Morecroft shares with Prof Chaffee a certain shakiness of hand when he takes up his pen for chap 1, but he too makes a quick recovery That the easy bits are the most difficult to write is no new discovery, but these erudite writers really ought to submit the manuscript of their first chapters to their youngest students for approval A salutary change between the things said at too great length and those left out would result

It is not at all a destructive criticism to say that Morecroft s work is more slender and superficial than Chaffee's These are, indeed, its essential merits, and it will do much to stimulate the best of its readers to go on to Chaffee, vol 1, and to fill the temporary void left by the absence of Chaffee, vol 2 The stimulation is not notably helped by the classical 'carrot and donkey' method of which the author is over fond, both in the fine structure, where the reader first feels that he has been left with an inadequate treatment, and then discovers that his troubles are cleared up two pages or so later, and in the main plan, where the uses of the principal devices are relegated to chapters much later than those in which the devices are introduced and described The irritated 'donkey' may kick over the traces before he is assuaged by the deferred 'carrot'

The book gives an excellently up to-date survey of the whole field, generously interpreted to include not merely the devices which the English reader *will* go on calling 'valves , but also photoelectric cells, cathode ray oscillographs the many recent gas and vapour filled tubes, and even thermocouples The young engineer entering industry from the technical school, to whom the work is addressed, will be a dull 'donkey' indeed if he is not fired to enthusiasm by the author Heat shielded cathodes giving emission currents of 1 5 ampere per watt of heating supply, ultramicrometers measuring deflections of a few atomic diameters, thermionic ammeters measuring currents of six electrons per second, and photoelectric eyes which can see fourteenth magnitude stars, are very succulent carrots' indeed

(3) Prof Barkhausen's classical work, in three volumes, is now passing through its fourth edition Vol 1 on general principles appeared in 1931, vol 2 on amplifiers is now before us, vol 3 on receivers is in preparation all having been rewritten A work by Prof Barkhausen, a work which has survived to a fourth edition, and a work thus brought up to date needs no discussion it has commended itself

Morphogenesis in the Animal Embryo

The Elements of Experimental Embryology By Julian S Huxley and Dr G R de Beer (Cambridge Comparative Physiology) Pp xiii+514 (Cambridge At the University Press, 1934) 25*s* net

THIS work is a rather surprising addition to the Cambridge Comparative Physiology series—surprising partly because it is twice as heavy as any of the earlier members of the series, and partly because it deals with what may perhaps be called one of the backward branches of biological science While the analysis of animal chemistry and animal energetics advances very rapidly in precision, the analysis of animal morphogenesis lags far behind If, for example, we turn to the study of animal behaviour, we find the observable phenomena described in terms of (*a*) the physico chemical properties of nerve cells and (*b*) the manner in which the cells are arranged in the nervous system , and while our understanding of the facts of the first group—of such processes as nervous conduction, excitation, inhibition and so forth—is rapidly advancing and increases almost literally from day to day, we know relatively little of the processes which have led the neurones to assume the patterns in which in fact they lie, and which determine, equally with their physico chemical properties, the reactions which the organism will give in any given circumstances The reason for this discrepancy is not far to seek Physiological analysis depends very greatly, for its ideas and methods, on physics and chemistry and in these sciences the emphasis has lain on quantities rather than on shapes

The authors of the volume under review are fully alive to this difficulty They have not attempted to review in their book all that is known about morphogenesis, but restrict themselves to what Wilhelm Roux termed the pre functional stage of development, that is, to the stage which begins with an undifferentiated, or relatively undifferentiated, egg, and ends with an embryo in which the main organs are laid down and the tissues histologically differentiated, adding only a brief chapter on the effects of function, both on the organ which functions and on other organs Moreover, they have restricted themselves in another way They do not attempt to analyse the processes involved in terms of physics and chemistry In their view, the field is not yet ripe for that harvest They work on what they term "the biological level ' To quote their preface

> The prime aim of the worker approaching the problem on the physiological level will always be to analyse the processes involved in terms of physics and chemistry The worker on the biological level will aim at discovering general rules and laws which he is content to leave to his physiological colleague for future analysis in more fundamental terms, but which, meanwhile, will give coherence and a first degree of scientific explanation to his facts Both methods are necessary for progress and while most biologists hope and expect that one day their laws will, thanks to the labours of their physiological colleagues, be made comprehensible in the most fundamental physico-chemical terms, they can reflect that it is they who must first reveal the existence of these laws before the physiologist can hope to begin his analysis "

In pursuing this aim, the authors have amassed and classified a vast amount of very entertaining facts Their method is to take as type the development of the amphibian embryo, on which of recent years a large amount of important work has been done, and then to turn to other animals to see how far the conclusions reached in connexion with frog and newt eggs can be usefully extended and generalised At first sight their volume contains more anecdote than law—it is a fascinating and exciting browsing ground—but as one reads there does emerge a framework of general principle a series of fundamental biological facts for the physiologist to explain Let us hope that he will read this volume and take up the challenge

As one expects from the authors the book is thoroughly up to date, and, by gathering together a great amount of work along different lines brings out suggestive relationships and generalisations There is an excellent bibliography, and important work that appeared after the book was in page proof is summarised in an appendix Occasionally criticisms suggest themselves, especially when the authors veer towards the physiological level For example, in discussing the development of pigment cells in the fish *Lebistes* they write "Specimens reared on white backgrounds have contracted melanophores, few in number, specimens reared on dark background have expanded melanophores in large numbers Functional activity increases rate of multiplication" There is, of course, no reason to suppose that an expanded melanophore is more "functionally active" than a contracted one The evidence collected to suggest that minute differences in oxygen supply between the ends of egg cells is a factor in determining polarity is perhaps unconvincing in the light of recent investigations on the shape of the curve relating oxygen tension to oxidation rate in single cells These are however, small points and in collecting this great array of fact and subjecting it to a preliminary regimentation the authors have, it is hoped, greatly assisted and accelerated the ultimate analysis to which they look forward

G P W

Short Reviews

Board of Education Science Museum *Handbook of the Collections illustrating Aeronautics* 2 *Lighter than Air Craft, a Brief Outline of the History and Development of the Balloon and the Airship, with reference to the National Aeronautical Collection, and a Catalogue of the Exhibits* By M J B Davy Pp 112+32 plates (London H M Stationery Office, 1934) 2*s* 6*d* net

MR DAVY, the officer in charge of the Aeronautical Collection at the Science Museum, South Kensington, has, with the issue of this book, completed a series of three, which constitutes a very completely annotated catalogue to the collection of aeronautical exhibits at that Museum, in addition to providing a concise and useful history of aeronautics in Great Britain The companion volumes already issued, are vol 1 "Heavier than air Craft and vol 3 "Propulsion of Aircraft

These books are astonishingly full of meat presented in an orderly and readable manner, and read in conjunction with visits to the collection cannot fail to educate visitors in the part that Great Britain has played in the development of the science of mechanical flight, a history which is all too little known or appreciated It is a pity that in a few instances the author does not stick to the definitions laid down in the "British Standard Glossary of Aeronautical Terms" Many of these are admittedly subjects of controversy, but confusion of terms can only be removed by strict loyalty to the agreed authorities in the matter For example chap v is headed Pressure Type Air ships ' This term was deliberately omitted from the British Standard Glossary in favour of the two sub divisions non rigid and semi rigid airships

The book is divided into chapters dealing with the early speculations as to lighter than air flight , hot air balloons , spherical hydrogen balloons , early dirigible balloons or airships , non rigid and semi rigid airships, and rigid airships It covers a period from Roger Bacon (1214) to a reference to the *Akron* disaster in the U S A (1933) The illustrations are particularly good, and add considerably to the usefulness of the volume

The Ape and the Child a Study of Environmental Influence upon Early Behavior By Prof W N Kellogg and L A Kellogg (Whittelsey House Publication) Pp xiv+341+33 plates (New York Mc Graw Hill Book Co , Inc , London McGraw Hill Publishing Co , Ltd , 1933) 12*s* 6*d* net

IF a baby ape were brought up in human surroundings and treated like a human child, how far would it acquire human characteristics ? This is one of the problems Prof and Mrs Kellogg have tried to solve in the unique experiment related in this book Gua, a female chimpanzee, was reft from her mother at the tender age of 7½ months, and brought up in the Kellogg household with their son Donald, who was 2½ months older They lived together as companions and playmates for nine months, being treated in every way as nearly as possible alike, and they became great friends A very detailed study was made of their sensory and motor capacities, their power of learning, their rate of maturation The little ape showed herself surprisingly intelligent, though not quite up to the level of the child in some respects, as in muscular strength and co ordination, she was the child's superior, due in part to her more rapid rate of development Simple things she learned more rapidly than the child, probably for the same reason

A detailed comparison with the behaviour of an ape brought up in the normal way is unfortunately not given, but it is clear that Gua was considerably affected and stimulated to higher flights by her new and exciting psychological environment 'It is clearly in defence of the capacities of the animal that the results of the present research are most significant They strongly suggest that, if given sufficient opportunity, the animal subject may considerably outdo himself, particularly if he belongs at a high level in the biological scale (p 322) There is a vast amount of useful material in the book for the student of child and anthropoid psychology

E S R

A Text Book of Inorganic Chemistry Edited by Dr J Newton Friend (Griffin's Scientific Text Books) Vol 6, Part 2 *Phosphorus* By Dr Edmund B R Prideaux Pp xxviii+238 (London Charles Griffin and Co, Ltd, 1934) 18*s* net

THE part of Friend s Text Book of Inorganic Chemistry" which deals with phosphorus and its compounds has been written by Dr Prideaux on similar lines to those in which the other elements have been described, and maintains the characteristic features of the series This statement implies that the book is traditional rather than modern in its methods and outlook, and is therefore of more value as an index to the published literature than as a stimulant to research in its broader aspects Since Dr Prideaux is keenly interested in problems of valency, in reference to which he has himself made original contributions, it is an anomaly (for which the editor is perhaps responsible) that, although data are cited for the parachor of phosphorus oxychloride, no reference is made to their interpretation by means of a semi-polar bond, and that when, in certain rare instances, structural formulæ of compounds of this type are set out in full, the atom of phosphorus is associated with five bonds

The book may therefore be commended without reserve to those who wish to study fundamental chemistry, undefiled by any taint of modernism, but it will disappoint those who may consider that the problems of molecule building are too important to be discussed adequately in three paragraphs of less than half a page each in a book of more than 200 pages

Handbuch der Chemotherapie Von Dr Viktor Fischl und Prof Dr Hans Schlossberger Teil 2 *Metallderivate* Pp xi+359–898 (Leipzig Fischers medizinische Buchhandlung, 1934) 55 gold marks

THIS second volume completes the work (the first volume of which was reviewed in NATURE, 132 694 1933) and is provided with an adequate index covering the contents of the two volumes The issue of a third volume comprising a general section on theories of chemotherapy has been postponed with the laudable object of preventing the book from becoming at once too bulky and too costly The projected third volume will either appear as an independent work or be added if and when a new edition is required

The metallic derivatives (including those of fluorine and iodine) are treated on the same plan and with the same clarity and precision as the metal free organic compounds in vol 1 Of special value are the introductory historical surveys of the therapeutic use of each element

One third of the book is devoted to arsenic compounds, of which there is a very full account Incidentally, the Styrian arsenic eaters are said to have taken the trisulphide whereas it is generally understood that they consumed the oxide Special sections are devoted to the compounds of antimony bismuth, copper, silver, gold, mercury and the rare metals

The work forms a valuable addition to the literature of the subject, and the authors are to be congratulated on its speedy completion

The African To day By Prof Diedrich Westermann (Published for the International Institute of African Languages and Cultures) Pp xv+343 (London Oxford University Press, 1934) 7*s* 6*d* net

THOSE who wish to know something of present day conditions in native Africa and to understand why and how things have come to be as they are, may take up this book with confidence that what is essential will be found in its pages and for the most part told at first hand Dr Westermann explains the ethnic composition of the African peoples, their linguistic affinities, and demonstrates the constituents of their culture In the case of the last named, taking each aspect in turn, religion, social organisation, economics, material culture and the like, he shows how they have come into contact with European civilisation, the resulting modification in each instance, and its effect on native life generally Tendencies and possibilities are carefully considered

The book should be read in conjunction with the scheme for African research of the International Institute of African Languages and Cultures, more familiarly known as the 'Five Year Plan', to which indeed Dr Westermann makes frequent reference The prolegomena to that plan and Dr Westermann's book give a plain statement of facts, which should not be ignored in the future political and economic policy of Africa

Surface Tension*

By Dr. Allan Ferguson

OUR subject is very closely associated with the comprehensive topic of cohesion, a topic which attempts an answer—not to the problem *why* we are here to-night, which is a matter for the theologians to discuss—but the problem, *how* we are here, in our present habits, and not as a chance medley of unattracting atoms. To attempt to answer such a query takes us very far towards the fundamentals of atomic structure and behaviour, but the problem, as we envisage it in the light of to-day's theories, still bears a strong resemblance to the problem as it was posed and answered, by van der Waals. How comes it that, if material particles attract each other the whole structure of the universe does not collapse under these attractions? We can formulate an answer to the question if we take into account the thermal motions of the particles. "In nature it is cohesion between atoms which tends to produce condensation and solidification and temperature which tends to produce dissociation. Temperature is a manifestation of kinetic energy and cohesion of potential energy and the interplay of these two forms of energy is responsible for many of the observed physical properties of matter" (Lennard-Jones). Cohesion and temperature—these, then, are the protagonists who play out the drama.

The main change of view during the last generation depends on the change which has taken place in our concept of the ultimate material particle and the structure of the atom. The billiard ball atom of the nineteenth century physicist served its purpose well, and subserves a useful function to-day. It is not surprising that so naïve an extrapolation of our large scale processes should ultimately break down—the surprising matter is that the extrapolation should have proved so brilliantly successful as it has done. Such a type of atom was assumed to have a definite size, and this notion of clear-cut dimensions was not lost when it was found that the concept was not fine grained enough to interpret successfully radioactive phenomena, and the nuclear atom displaced it. Here the concept of size was associated with the dimensions of the electronic orbits and, though the atom became a far more complex system, there was no haziness about the notion, apart from the difficulty of an exact determination of its dimensions.

We have changed all that to-day. We cannot hope to locate our electrons precisely and the definite orbit of the electron of the nuclear atom is now replaced by a *probability pattern*, the density of the pattern at any point measuring the probability of finding an electron there. Fortunately, the uncertainty which we have introduced into our concepts has not seriously altered our views concerning the order of atomic magnitudes, inasmuch as the probability of finding an electron in any particular pattern becomes infinitesimal outside regions of the magnitude of about one hundred millionth of a centimetre. We may still, therefore, keep to an interpretation of the size of an atom which, despite a little cloudiness at the edges, does not differ materially from the interpretation based on the older concepts.

What are, then, the dimensions of the atoms and molecules with which we have to deal? Any example that we may give to illustrate the meaning of such atomic magnitudes merely transforms an inconceivably small number into an inconceivably large one; let it suffice to say that if we could curb the liveliness of the hydrogen atoms and lay them in order on a sixpence, it would take some eight hundred million years of unceasing work to cover the coin, if we laid our atomic bricks at the rate of one a second.

We shall, therefore picture a liquid as a congeries of such particles in lively thermal motion, attracting and being attracted according to a law which we need not attempt to specify more closely than by saying that the attraction of any one molecule on its neighbours falls off very rapidly as the distance increases. If then we draw round any one molecule well in the interior of the liquid, a small sphere the radius of which we may term the range of molecular attraction, the central molecule will experience no resultant force due to the attractions upon it of its neighbours within this sphere.

It is otherwise if the central molecule is at a distance from the surface of the liquid which is less than the radius of this sphere. Part of the sphere is now outside the liquid, the molecules therein are missing, and do not contribute their share to the force on the molecule at the centre of the sphere, which molecule therefore experiences a force urging it into the liquid. To transport a molecule from the interior of the liquid into the liquid surface against such a force requires, therefore, the expenditure of *work*; and inasmuch as the conveyance of molecules into the surface means an extension of the surface, to extend a liquid surface necessitates the expenditure of work. Stretch a sheet of rubber, and notice that we have to do work to extend the rubber surface.

We must not press simple analogies too far, but it is legitimate to assume that the surface of a liquid behaves as if it were in a state of tension, and the tension in the surface across a line of unit length drawn in the surface is called the *surface tension* of the liquid. We may demonstrate its existence by forming a soap film on a circle of copper across which a loose thread of cotton has been tied. Destroy the film on one side of the thread, and the thread is pulled by the tension of the film on the other side into a very perfect arc of a circle. This tension differs for different substances, as we may show by pouring a little alcohol on to a thin film of coloured water at the bottom of a glass dish, and noting how a clear space is formed in the middle of the dish where the alcohol —the liquid of weaker tension—was poured in

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* From a Friday evening discourse delivered at the Royal Institution on February 16.

For any one liquid, the tension decreases with increasing temperature We may show this by scattering lycopodium on the surface of water in a dish, and bringing a heated bit over the centre of the dish The greater tension of the cold water is clearly shown by the way in which the central space is swept clear of the powder Following Lord Kelvin's dictum that we know something about a quantity when we can make measurements thereon, it may not be amiss to state that the law connecting surface tension (γ) with temperature (θ) is $\gamma=\gamma_0(1-b\theta)^n$, where b is very accurately the reciprocal of the critical temperature, and n, which varies only slightly from liquid to liquid, may be assumed to have a mean value of 1·2 This relation holds good for *unassociated* liquids A film of oil covering a thin rod breaks up into a series of regularly spaced drops, illustrating the instability of a liquid cylinder the length of which exceeds its circumference A similar result may be illustrated for a liquid annulus by cutting a narrow circular groove on the lower surface of an iron disk, placing the disk on a horizontal glass plate and filling the groove with mercury On lifting the disk, the ring of mercury breaks up at once into a series of regularly spaced drops

These drops take on an approximately spherical form, and the tendency to sphericity becomes more pronounced as the drops become smaller, and those forces, such as the weight of the drop, become increasingly unimportant in comparison with the surface forces A spherical surface is that surface which, for a given volume, has a minimum area, and this tendency to the exposure of the smallest possible extent of surface illustrates the principle that a dynamical system tends to take up a position in which its potential energy is a minimum

Another experiment we owe to the ingenuity of Major C E S Phillips Two light vertical rods serve as supports To the top of one is fixed a *circular* microscope cover slip with its plane horizontal, the other support carries a horizontal *square* cover slip Two other slips, one square, one circular, carry fastened to their upper surfaces long and light straw pointers Lay these on the top of the fixed slips, and, clearly, you can spin them round as you will But now place a drop of water between each of the pairs of slips, and endeavour to revolve the upper movable slips The circular one moves freely over its circular fellow and remains with its pointer pointing in any direction which you choose to give to it Displace the square one, and it snaps back into a perfectly definite position of equilibrium in which the upper slip is exactly congruent with the lower It is a delightful experiment, and one is tempted to say of it, *mutatis mutandis*, what Praed said of the Vicar's sermons

These few fundamental principles, consistently applied, will serve to elucidate a great many problems in which surface energy plays a dominant part

But we must hasten to the second part of the discourse, which is concerned with a very commonplace phenomenon—that of the detachment of a drop of liquid from a vertical tube Study the process at any slowly dripping tap, and you will see that, although the initial stages may very easily be examined, the final stages of detachment occur with a rapidity which makes it impossible for the eye to follow them How may we slow the process ? Aniline and water are almost immiscible, and the density of aniline is but slightly greater than that of water If, therefore we form an aniline drop at the end of a vertical tube dipping into water, we may project the image of the drop on to a screen, and study the circumstances of its detachment with much greater ease

Pitch is a queer substance to forces of short duration it behaves as a solid, leave it to itself and it will flow like a liquid Pitch in a funnel gives a very perfect drop of pitch pendent from the stem of the funnel It seems static enough but although it flows, like Cæsar's Arar, *incredibili lenitate*, nevertheless it *does* flow, as a few months inspection would show

Yet another way in which we can slow down the process A sheet of indiarubber is stretched tambourine fashion, across a circular frame, and held in position by a serving of cord and a tourniquet If water is slowly run into the tambourine, the rubber first assumes a lenticular form and then takes on a position of equilibrium in which a pronounced waist is seen in the profile of the drop This position, impossible as an equilibrium position in a water drop is possible here because the tension in a rubber surface increases with the extension, whereas the tension in a liquid surface is, under conditions of constant temperature, independent of the extent of the surface This experiment was shown by Lord Kelvin at the Royal Institution in his Friday evening discourse of January 29, 1886 If his biographer ("Life of Lord Kelvin", p 854, vol 2) is a veracious chronicler the growth of the drop "furnished an exciting episode in the lecture, which culminated when finally the elastic film gave way and the drop burst over the lecture table, splashing the nearer members of the fashionably attired audience"

Even in 1886, it was possible to take an instantaneous photograph of the detachment of a drop of ink from a funnel, to-day the progress of high-speed kinematography has made it possible to follow the details of the process with the camera A high speed camera, developed in the Bell Telephone Laboratories in conjunction with the Eastman Kodak Company, makes it possible to take photographs at a normal rate of a thousand per second and, by overvolting the motor, we have been able to increase this rate to nearly two thousand per second. Obviously at these speeds the intermittent jerking of the film through the camera is impossible, and the film hurtles past the lens at a uniform speed of close on thirty miles an hour when the motor is overvolted. Between the lens system and the vertically descending film is a prism which can be rotated about a horizontal axis at a maximum speed of eighty thousand revolutions per minute, and this prism permits twice in each revolution of the passage of light from lens to film, and therefore exposes an image on the film for a period of the order of one five-thousandth of a second. There is no special difficulty in the illumination of the object, in all the experiments to be described a thousand watt lamp and a simple projector gave all the illumination necessary. A special feature of the camera is a two-dialled clock, one of the dials rotates once a minute and registers seconds; the other dial rotates once in a second and is graduated into five hundred divisions in such a way that thousandths of a second may be estimated. An auxiliary prism throws the images of these dials on the film, and the time relations of the phenomenon under observation may therefore be registered with very high accuracy.

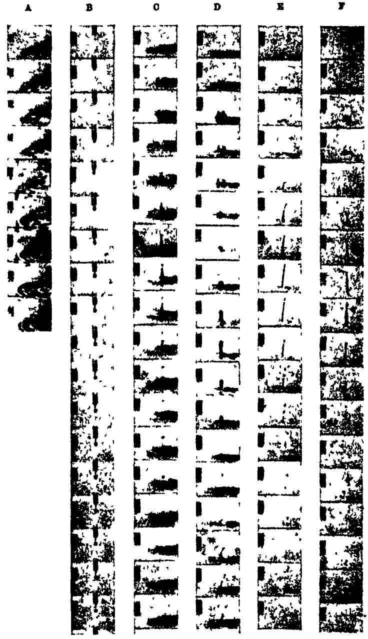

Fig 1

Readers of the fantasies of Mr. H G Wells will remember that delightful story in which the hero takes a drug which temporarily alters his time-scale of living. Under its influence he writes a three-hour article at what he presumes is his normal rate; when the effect of the drug has worn off he finds that he has accomplished his task in a few minutes. He takes a walk, and notices a bee flapping its wings lazily in the wind, he accelerates his speed, and is brought up by a smell of burning—the rapidity of his motion through the air has caused his trousers to singe.

Suppose, then, we make an attempt to enter a world the time scale of which is such that we can study the manner in which a drop detaches itself from a tap—we can do this by running a film taken by the high-speed camera through the projector at a rate of fifteen or twenty pictures a second. We have altered our time scale in the ratio of about a hundred to one. In this way (Fig. 1, B) all the stages of the detachment of a drop, and the lenticular form, the waist formation, the drawing-out of a long neck and the final detachment of the drop and its accompanying satellite can be followed with the greatest ease.

But the most interesting application of kinematography of this type which I have as yet been able to make, is the study of the beautiful phenomena described some thirty or forty years ago by Prof. A M. Worthington, who photographed the splash of a drop of liquid into liquid, of a solid sphere into a liquid, and of a liquid drop falling on to a solid plate ("A Study of Splashes", 1908). That something odd happens when, *ex gr.*, a drop of water falls on a smoked glass plate is well seen on these slides, the radial striations on which show that the drop has been throwing out arms in what, at first sight, seems a very queer fashion.

Worthington investigated the phenomenon by taking an instantaneous photograph of, say, a drop of water falling into milk at a certain stage of its fall and then, by an ingenious timing device, ensured that a second drop, released under conditions identical with those of the first drop, should be illuminated instantaneously at a stage of its fall one five hundredth of a second later than that stage at which its predecessor was illuminated, and so on. Worthington, in fact, took photographs of different drops at varying stages of their careers and from the photographs pieced together the life history of a single drop. The high speed camera enables us to do this directly, and frees us from certain obvious complexities introduced by the varying behaviour of different drops—complexities which, on occasion, proved very puzzling to Worthington.

The film (Fig. 1 A) which shows the splash of a water drop into water is not perhaps so spectacular as some of the others but it has a mild historical interest inasmuch as it is, I think, the first film to show the phenomenon, and it was actually our first film, taken with no special precautions as regards stopping of the lens and illumination. Addition of a little milk to the water brings out the detail, and it is most interesting to note how closely the story follows that unfolded by Worthington's pictures. We see the effect of a low fall, about 40 centimetres (Fig. 1, C) and of a high fall, about a metre (Fig. 1, D), the high fall showing very beautifully the stages in the process of bubble formation on the surface of the liquid. In Fig. 1, E and F, are shown the effects of a low and of a high fall due to an ordinary rough marble sphere falling into a liquid. The whole story of these events is told in something of the order of half a second, and the slow motion projection enables us to multiply this period by a factor of about a hundred.

The splash of a drop of mercury on a glass plate is a little more difficult to follow—it is over in about a twentieth of a second, and even the high speed camera is not quick enough to enable us to grasp the complete detail. Nevertheless, we hope to be able to speed up the camera still further, and this gain of speed, with the aid of the technique of the photographer, may make it possible to show to an audience even so evanescent a phenomenon as this.

Germination of Seeds*

By Sir Arthur W. Hill, K.C.M.G., F.R.S.

We may now consider those seeds which on germination escape from their endocarps or stones by throwing off a specially prepared portion only of the endocarp wall. The best examples of such fruits, enclosing a single seed, are afforded by the tupelos, *Nyssa*, and by *Mastixia*, both belonging to the family Cornaceæ. The valve, which is thrown off on germination, which may be compared to the shutter of a shop front, is about one third the length of the stone, square cut at the base, with a bluntly triangular apex. Until germination commences it is scarcely possible to see the outline of the valve, since the surface markings of the stone are continuous over the valve and the rest of the fruit. When germination commences and the substance cementing the valve to the rest of the endocarp is dissolved, the radicle pushes off the shutter, which becomes completely detached, and so the embryo effects its escape. It is of interest to notice that specimens of fossil seeds of *Nyssa* and *Mastixia*, found in Eocene beds in the Isle of Wight and in Pliocene beds of the Dutch Prussian frontier, show the valve structure perfectly. There is a further interest in these fossil seeds, since *Nyssa* to day is only known in the eastern United States, the Himalayas and the Malayan Islands, and *Mastixia* in India and the East Indies.

The cornels, *Cornus*, have fruits of a similar character, but differ in having two seeds enclosed in an endocarp, which necessitates the splitting off of two shutters, one for each embryo, when germination commences. As in *Nyssa*, the shutter has a horizontal base and before germination takes place the presence of the valves or shutters cannot be detected.

The fruit of *Canarium* (Burseraceæ) contains three seeds enclosed in a stony endocarp. The hard woody valves or shutters are triangular ovate, pointed at the apex and horizontal at the base, and are about two thirds the length of the stone. On the inside they are concave. The seed cavity is the full length of the stone and the radicle of the embryo is at its broader upper end. On germination, the radicle pushes the shutter upwards and the arch of the hypocotyl raises the shutter still more. The embryo, however, is well surrounded by its seed coats and in order to extract its cotyledons properly a peg like structure is developed at the apex of the radicle on the seed side, which grows over the lower edge of the stone much as in the vegetable marrow. The young seedling thus treads on the floor of its prison box, keeping it firmly on the soil, while the hypocotyl, exerting its full pressure, withdraws the cotyledons both from their own seed coats and from their wooden, box like prison.

The seeds of the teak tree (*Tectona grandis*, Verbenaceæ) show a similar arrangement of shutters. Here, however, there are four cavities in the endocarp and the four shutters extend nearly the whole length of the stone. When the shutters are thrown off on germination the destruction of the prison has been so complete that only the partition walls remain. *Saccoglottis* and *Aubrya* (Humiriaceæ) may be mentioned in passing, since in them five embryos may be incarcerated, each in its separate cell. They too escape by taking down the shutters.

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* *Continued from p.* 859

Davidia, another of the Cornaceæ, a remarkable Chinese tree introduced to cultivation a few years ago—which, when in flower, resembles a large wash of white pocket handkerchiefs hung out to dry—has the most complicated of the shutter devices for imprisoning or safeguarding the seeds. In this plant seven or more seeds may be contained in each stony endocarp and, as they lie close together, only one seedling is likely to survive owing to overcrowding, since they cannot get away from their fellows. The protection for the embryos is admirable, but almost over ingenious, since the object in view, the propagation of the species, is somewhat defeated when so many good seedlings must eventually perish. This almost suggests a 'slum' analogy! The hard stony endocarp of *Davidia* is deeply fissured and when ripe no trace of the shutter-like valves can be seen. The shutters, however, as a cross section shows, are all prepared and ready to be loosened when the opportunity comes. The shutters are similar to those already described—some two thirds the length of the stone, long, narrow and thick, and hollowed on the inside. On germination not only is the shutter thrown off, but also a portion of the endocarp wall or rib between each shutter is shed, and this portion, no doubt, serves to cement the seeds or ovules all the more securely and hermetically in their narrow cells. As I have already mentioned, however, many of the escaped prisoners die of starvation due to overcrowding, since they are unable to move away from the neighbourhood of their former prison.

I must now direct attention to a somewhat different method of imprisonment by means of cork like stoppers and lids. The fruit of the mare's tail, *Hippuris*, a well known British water plant, contains a single seed, and the endocarp, which in this case is not hard and stony, is shaped like an ovoid bottle and corked at the neck by a plug or stopper of hardened tissue. It may be compared to a test tube plugged with a stopper of cotton wool. On germination, the radicle of the embryo within the cavity or tube forces out the stopper, like the ejection of a champagne cork, and so effects its escape.

The large, woody, spherical fruits of *Northea seychellana* (Sapotaceæ) shew a small circular area at one end, which proves to be a cap fitting into and closing an orifice, beneath which lies the radicle of the embryo. This cap is pushed off on germination and the shoot apex is pulled out into freedom through the orifice by the lengthening of the stalks of the cotyledons which, themselves, remain within the seed.

It is when we come to examine the fruits of various members of the Anacardiaceæ, the family to which the cashew nut, mango, pistachio nut and other edible fruits belong, that we find some remarkable contrivances for the protection of the seeds, and equally ingenious devices by which they make their escape on germination.

Hæmatostaphis, the blood plum of Nigeria, is an example of a stony endocarp with a lid containing a single seed. On removal of the flesh of the fruit a small lid like structure can be seen at the apex of the stone, which forms a close fitting stopper, hermetically sealing the orifice of the cavity in the endocarp in which lies the embryo with its radicle directly under the lid. On germination the lid separates into two halves, like a pair of doors which are pushed aside by the emerging radicle. Before germination there is no indication that the lid is a double structure which can be thrown open for the exit of a visitor, like front doors of a millionaire's mansion!

The Kaffir plum of South Africa, *Sclerocarya caffra* and *Dracontomelon* from the East show similar devices to *Hæmatostaphis*, except that in the former, three, and in the latter five, embryos are enclosed in each stony endocarp. The cavities containing the seeds or embryos are in each case closed with a cap like lid, in shape like a circular military cap, some 3 mm. thick, hollowed out on the inner side and thinned out at the lower corner. This is the weak spot in the armature through which external moisture can enter when the fruits are sown, and it is also the spot at which the embryo makes its attempt at escape by pushing up the cap with its developing radicle.

During the War some fruits were picked up in the East end of London, after an air raid; they were sent by the Home Office to the Pharmaceutical Society for examination and thence to Kew for determination, as it was thought they had been dropped from an enemy aeroplane with sinister purpose, since they were succulent and edible. The fruits proved to be those of *Dracontomelon sinense* and had no doubt been dropped by some sailor home from the East!

A yet more elaborate and complicated device remains to be described in this same family *Anacardiaceæ*, which has been evolved in the genus *Pleiogynium*, the Burdekin plum of Queensland, Australia. Here the seeds are not only enclosed in stony endocarps, but also to ensure more complete protection of the embryo, the middle portion of the fruit—the mesocarp—has become stony, and the stony endocarps are, in addition, surrounded and enclosed in an outer, woody box, like the proverbial pessimist who considers it essential to wear braces in addition to a belt! Here, again, the protection seems to have somewhat overshot the mark; for some twelve seeds are imprisoned in this outer turbinate, woody box (2·8 cm. in diameter), and ultimately, on germination, only one of the seedlings is likely to survive in the competition with its close neighbours.

Each stony endocarp in this enclosing box has a lower tubular portion more or less fused with the tissues of the mesocarp, and an upper cap-like portion firmly cemented to the lower part, which becomes detached on germination and is pushed through the orifice in the mesocarp so that the embryo can emerge The caps are somewhat similar to those of *Sclerocarya* and *Dracontomelon*, but they are triangular in section and hollowed within to contain the upper part of the embryo In shape they resemble a French forage cap

The extreme case of wastage of effort is that of the Brazil nut, *Bertholletia* When you purchase Brazil nuts, you rarely, if ever, see the fruit body in which they are contained The well known 'nuts' are the seeds with their strong, woody seed coat, but they are contained in a large, woody, spherical fruit some six inches in diameter, with a wall half an inch thick and as hard as well seasoned oak, with a smooth, glass-like inner layer At one end of the ball there is a small orifice firmly plugged by a stopper, and inside the 15–20 seeds are so neatly packed, with their thin edges inwards, that the hollow wooden sphere is completely filled, and no space is wasted When conditions are favourable for germination, the seeds inside all commence to germinate at once The orifice, half-an inch across, however, is their only means of escape, as the fruit wall remains hard and intact The result may be compared with the rush of a crowd on the call of "Fire" at a theatre Every one tries to get out at once and only one out of the 15–20 prisoners survives! Surely this is a case where the means have defeated the end

Tennyson may well have had the Brazil nut in mind when, referring to Nature, he wrote

> So careful of the type she seems,
> So careless of the single life,
>
> That I, considering everywhere
> Her secret meaning in her deeds,
> And finding that of fifty seeds
> She often brings but one to bear,
>
> I falter where I firmly trod,"

Why should some seeds, like those of many orchids and lilies, papery in their texture and almost transparent, survive perfectly well in a dormant condition for a long period, while others need a strong protective envelope?

All these questions relating to the nature of the life in a dormant seed, whether germination may be immediate or may be long delayed, and the ingenious methods of germination, afford problems of much interest, all the more so since they are so illusive and because our attempts to solve them are confronted by so many difficulties

Possible Production of Elements of Atomic Number Higher than 92

By PROF E FERMI, Royal University of Rome

UNTIL recently it was generally admitted that an atom resulting from artificial disintegration should normally correspond to a stable isotope M and Mme Joliot first found evidence that it is not necessarily so, in some cases the product atom may be radioactive with a measurable mean life, and go over to a stable form only after emission of a positron

The number of elements which can be activated either by the impact of an α particle (Joliot) or a proton (Cockcroft, Gilbert, Walton) or a deuton (Crane, Lauritsen, Henderson, Livingston, Lawrence) is necessarily limited by the fact that only light elements can be disintegrated, owing to the Coulomb repulsion

This limitation is not effective in the case of neutron bombardment The high efficiency of these particles in producing disintegrations compensates fairly for the weakness of available neutron sources as compared with α particle or proton sources As a matter of fact, it has been shown[1] that a large number of elements (47 out of 68 examined until now) of any atomic weight could be activated, using neutron sources consisting of a small glass tube filled with beryllium powder and radon up to 800 millicuries This source gives a yield of about one million neutrons per second

All the elements activated by this method with intensity large enough for a magnetic analysis of the sign of the charge of the emitted particles were found to give out only negative electrons This is theoretically understandable, as the absorption of the bombarding neutron produces an excess in the number of neutrons present inside the nucleus, a stable state is therefore reached generally through transformation of a neutron into a proton, which is connected to the emission of a β particle

In several cases it was possible to carry out a chemical separation of the β active element, following the usual technique of adding to the irradiated substance small amounts of the neighbouring elements Those elements are then separated by chemical analysis and separately checked for the β activity with a Geiger Müller counter The activity always followed completely a certain element, with which the active element could thus be identified

In three cases (aluminium, chlorine, cobalt) the active element formed by bombarding the element of atomic number Z has atomic number $Z - 2$ In four cases (phosphorus, sulphur, iron, zinc) the atomic number of the active product is $Z - 1$ In two cases (bromine, iodine) the active element is an isotope of the bombarded element

This evidence seems to show that three main processes are possible (*a*) capture of a neutron with instantaneous emission of an α particle; (*b*) capture of the neutron with emission of a proton, (c) capture of the neutron with emission of a γ-quantum, to get rid of the surplus energy From a theoretical point of view, the probability of processes (a) and (b) depends very largely on the energy of the emitted α or H-particle, the more so the higher the atomic weight of the element The probability of process (c) can be evaluated only very roughly in the present state of nuclear theory, nevertheless, it would appear to be smaller than the observed value by a factor 100 or 1,000

It seemed worth while to direct particular attention to the heavy radioactive elements thorium and uranium, as the general instability of nuclei in this range of atomic weight might give rise to successive transformations For this reason an investigation of these elements was undertaken by the writer in collaboration with F Rasetti and O D Agostino

Experiment showed that both elements previously freed of ordinary active impurities can be strongly activated by neutron bombardment The initial induced activity corresponded in our experiments to about 1,000 impulses per minute in a Geiger counter made of aluminium foil of 0 2 mm thickness The curves of decay of these activities show that the phenomenon is rather complex A rough survey of thorium activity showed in this element at least two periods

Better investigated is the case of uranium, the existence of periods of about 10 sec, 40 sec 13 min plus at least two more periods from 40 minutes to one day is well established The large uncertainty in the decay curves due to the statistical fluctuations makes it very difficult to establish whether these periods represent successive or alternative processes of disintegration

Attempts have been made to identify chemically the β active element with the period of 13 min The general scheme of this research consisted in adding to the irradiated substance (uranium nitrate in concentrated solution, purified of its decay products) such an amount of an ordinary β active element as to give some hundred impulses per minute on the counter Should it be possible to prove that the induced activity, recognisable by its characteristic period, can be chemically separated from the added activity, it is reasonable to assume that the two activities are not due to isotopes

The following reaction enables one to separate the 13 min product from most of the heaviest elements The irradiated uranium solution is diluted in 50 per cent nitric acid a small amount of a manganese salt is added and then the manganese is precipitated as dioxide (MnO_2) from the boiling solution by addition of sodium chlorate The manganese dioxide precipitate carries a large percentage of the activity

This reaction proves at once that the 13 min-activity is not isotopic with uranium For testing the possibility that it might be due to an element 90 (thorium) or 91 (palladium), we repeated the reaction at least ten times, adding an amount of uranium $X_1 + X_2$ corresponding to about 2,000 impulses per minute, also some cerium and lanthanum were added in order to sustain uranium X In these conditions the manganese reaction carried only the 13 min activity, no trace of the 2,000 impulses of uranium X_1 (period 24 days) was found in the precipitate, and none of uranium X_2, although the operation had been performed in less than two minutes from the precipitation of the manganese dioxide, so that several hundreds of impulses of uranium X_2 (period 75 sec) would have been easily recognisable

Similar evidence was obtained for excluding atomic numbers 88 (radium) and 89 (actinium) For this, mesothorium 1 and 2 were used, adding barium and lanthanum, the evidence was completely negative as in the former case The eventual precipitation of uranium X_1 and mesothorium 1 which do not emit β rays penetrating enough to be detectable in our counters would have been revealed by the subsequent formation respectively of uranium X_2 and mesothorium 2

Lastly we added to the irradiated uranium solution some inactive lead and bismuth, and proved that the conditions of the manganese dioxide reaction could be regulated in such a way as to obtain the precipitation of manganese dioxide with the 13 min activity without carrying down lead and bismuth

In this way it appears that we have excluded the possibility that the 13 min activity is due to isotopes of uranium (92), palladium (91), thorium (90), actinium (89) radium (88), bismuth (83), lead (82) Its behaviour excludes also ekacæsium (87) and emanation (86)

This negative evidence about the identity of the 13 min activity from a large number of heavy elements suggests the possibility that the atomic number of the element may be greater than 92 If it were an element 93, it would be chemically homologous with manganese and rhenium This hypothesis is supported to some extent also by the observed fact that the 13 min activity is carried down by a precipitate of rhenium sulphide insoluble in hydrochloric acid However, as several elements are easily precipitated in this form, this evidence cannot be considered as very strong

The possibility of an atomic number 94 or 95 is not easy to distinguish from the former, as the chemical properties are probably rather similar Valuable information on the processes involved could be gathered by an investigation of the possible emission of heavy particles A careful search for such heavy particles has not yet been carried out as they require for their observation that the active product should be in the form of a very thin layer It seems therefore at present premature to form any definite hypothesis on the chain of disintegrations involved

[1] E. Fermi, *Ricerca Scientifica*, 1, 5, 283 6, 330. NATURE, 133, 757 May 19, 1934 E Amaldi, O D'Agostino E Fermi, F Rasetti, E, Segrè *Ricerca Scientifica*, 5, 452, 1934

Obituary

SIR ROBERT CARLYLE, K C S I, C I E

ALTHOUGH even now natural science finds no place as a compulsory subject in the competitive examinations for the higher ranks of the public service, nevertheless the Indian Civil Service has often included in its ranks a few staunch supporters of the man of science In this select band the late Sir Robert Warrand Carlyle, a kinsman of the 'sage of Chelsea', whose death in his seventy fourth year occurred at Florence on May 23 last, takes an honoured place Four years ago he was seriously injured by a motor lorry in Essex, an accident which was followed by repeated attacks of pernicious anæmia which even his robust constitution could not long withstand

Educated at the University of Glasgow and Balliol College, Oxford, Carlyle passed the Indian Civil Service Examination in 1878 and was duly posted to Bengal In 1894 he reached the rank of magistrate and collector and served for many years in the District of Darbhangha, in which in 1904 Lord Curzon founded the Pusa Agricultural Research Institute After eight years service as a district officer he was called to headquarters at Calcutta, first as Inspector General of Police and then as Chief Secretary to the Government of Bengal

In 1907 Carlyle was selected for service under the Government of India as Secretary to the Department of Revenue and Agriculture and for the next three years came in the closest touch with most of the scientific workers employed by the Central Government, both administratively and also as chairman of the Board of Scientific Advice

With characteristic thoroughness, Carlyle applied himself to a close study of these somewhat unfamiliar activities, and also made a point of getting into personal touch with the workers themselves. In this latter task he was greatly assisted by Lady Carlyle, who took a deep personal interest in her husband's work and freely devoted her great social gifts to the entertainment of a constant stream of official visitors, many of whom were connected with some branch of science After three years' service as Secretary, Carlyle was promoted in 1910 to a seat in the Viceroy's Council, his charge including the Department of Revenue and Agriculture and also the Public Works portfolio, an appointment he held until his retirement in 1915

Carlyle was thus closely connected with the scientific activities of the Government of India for an unbroken period of eight years, during which he was particularly interested in agricultural research He was a great friend to the Pusa Research Institute, which he visited on many occasions, and he also found time to attend the meetings of the Board of Agriculture Under his fostering care the Institute developed with great rapidity the workers were constantly encouraged to give of their best The agricultural departments in the provinces were not forgotten Large sums of money were placed at their disposal for extensive seed farms for the production of pure seed of the new varieties of wheat created at Pusa and at other centres A new cane-breeding station was founded in South India at Coimbatore

Carlyle did much to foster and promote the co operative credit movement and to bring about effective liaison between its officers and those of the agricultural departments working in the Districts Other interests included the encouragement of the Indian Science Congress, the meetings of which his officers were permitted to attend while on duty, and at which they were given the greatest freedom in the reading and discussion of papers Carlyle was always insistent that the scientific workers under the Government of India should look upon themselves as free and independent investigators and not as members of a bureaucracy

The well being of agricultural research and the development of the co operative credit movement were only two of Carlyle's interests He did much to encourage the scientific study of forestry, he took a deep interest in the Survey of India and in the planning of New Delhi In these and other similar activities, the scientific workers concerned always found in him a sympathetic and responsive chief and one who spared no pains to understand their point of view and to make them feel that, so far as in him lay, they could rely on getting a square deal

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DR J D GIMLETTE

DR JOHN DESMOND GIMLETTE, whose death on April 24 we regret to record, was born on February 28, 1867 After gaining medical qualifications (M R C S, L R C P, London), as from St Thomas' Hospital, he at first designed entering practice in the English colony at Lisbon Later he joined the medical service of the Federated Malay States (Selangor, Perak and Pahang), eventually becoming Residency surgeon for Kelantan and Kota Bahru

In Malaya, Dr Gimlette soon became interested in native medicaments and poisons, a subject which occupied him up to the end In Kelantan, a region little tainted by Western influences, his opportunities were enhanced by innate knowledge of the language and by the confidence which his frank and sympathetic nature impressed on the Malay Jealous in regard to native secrets, they allowed him to witness, for example, mysteries such as those of Main Peteri, which are recounted in his work "Malay Poisons and Charm Cures" (Third edition, 1929 London Churchill)

Though much had been done botanically by Ridley, Burkhill, the workers at Buitenzorg amongst others, by his medical knowledge Dr Gimlette was to forge a link between the plant as such and as a drug A happy collaboration with Mr I H Burkhill led to the publication of a translation of the "Malay Book of Medicine" by Inche Ismail (*Gardens Bulletin*, Singapore, 6, 1930), to this is appended a 'catalogue raisonnée' of very great value Thereafter, in conjunction with Messrs Skeat and Thomson, he started on a more comprehensive and ambitious work to be entitled 'The Malayan Medical Dictionary' This work, though more than half done, is interrupted by his death, however, it is hoped that his collaborators will be able to complete it without undue delay He was also the author of many minor contributions on medical subjects During the War he was in charge of a hospital ship (*Essequibo*)

From his retirement from active service, Dr Gimlette was condemned to a sedentary life through the unfortunate loss of a leg from intense erysipelatous infection, but he stuck to his self imposed tasks with courage and pertinacity With the cardinal virtues of sincerity and thoroughness, no more loyal or lovable friend could be found, and there are very many who mourn his loss, whilst admiring his constancy of purpose in good and in failing health, though withal cheerful and of good heart

A final note of sympathy must be struck for his devoted widow, two small daughters, his sisters and other relatives H E DURHAM

WE regret to announce the following deaths

Dr E W Nelson, chief of the U S Federal Bureau of Biological Survey, known for his work on the birds and mammals of North and Central America, on May 19, aged seventy nine years

Sir Walter P Buchanan Riddell Bt, principal of Hertford College Oxford, in 1922–29, chairman of the University Grants Committee, on June 5, aged fifty five years

Mr J J Fahie, author of several standard volumes on the life and work of Galileo, on June 12 aged eighty seven years

Maj Gen George O Squier, K C M G, member of the U S National Academy of Sciences, known for his work in connexion with electrical communications, on March 24 aged sixty nine years

News and Views

International Conference on Physics

A MEETING of the International Union of Pure and Applied Physics will be held in October next in London and a joint conference will be held with the Physical Society, under the presidencies of Prof R A Millikan and Lord Rayleigh The last meeting of the Union took place in 1931 at Brussels (see NATURE of September 19, 1931, p 485), when an invitation from the Royal Society to meet in London was withdrawn in order to enable the Union to accept the American invitation for a meeting at Chicago at the Century of Progress Exhibition in 1933 Prof R A Millikan was elected president, but on account of economic conditions the meeting was cancelled and the Royal Society renewed its invitation to meet in London The invitation was accepted and the meeting will be held on October 1–6 The work of the Union will include consideration of the report of the Commission on Symbols, Units and Nomenclature appointed at its last meeting The Commission, under the chairmanship of Sir Richard Glazebrook, has dealt with electrical, calorimetric and thermometric units and work has also been done in connexion with radiometric and acoustical units Dr Hales' committee on Instruments and Instrumental Methods will, it is anticipated, desire to consult the Union on a number of questions Apart from this formal business, it was felt that the occasion should also be utilised for international discussion on a subject or subjects now attracting general interest, certain aspects of the solid state of matter were suggested as suitable

THE Physical Society had already decided to hold a Conference on Nuclear Physics and it was agreed to combine the two proposals Thus the meeting will take the form of an International Conference, on the joint invitation of the International Union and the Physical Society, under the presidencies of Prof Millikan and Lord Rayleigh the details are being arranged by a committee representing the two bodies The discussion on nuclear physics will be opened by Lord Rutherford with a general survey of the subject Subsequent papers will deal with cosmic radiation, β ray transformation of radioactive elements, artificial transmutations by α rays, neutrons protons and diplons and new types of radioactivity, and the constitution of atomic nuclei Sir William Bragg will deliver an opening survey in the discussion on the theory of the solid state of matter Papers on interatomic forces will be divided into three groups dealing with electrovalent linkings, covalent linkings and van der Waals attractions, as special consideration will be given to the action of these forces in metals at the Aberdeen meeting of the British Association, this particular section of the subjects will not be so fully considered at this discussion Another group of papers will deal with the possible existence of a secondary structure in crystals, coarser than the fine structure detected by X rays, and its relation to physical properties The names of delegates of national unions adhering to the International Union of Physics should be sent to the secretaries of the Conference not later than August 1 Invitations are being sent to a number of physicists known to be interested in these subjects, others desiring to attend should send in their names not later than September 1 All communications should be addressed to the Secretaries, International Conference on Physics, Royal Society, Burlington House, London, W 1

Memorial to Sir Walter Morley Fletcher

THE public life of Great Britain suffered a loss of more than common magnitude through the death of Sir Walter Morley Fletcher, first secretary of the Medical Research Council, on June 7, 1933 He was then in his sixtieth year and in the height of those powers which he had used without stint in the advancement of knowledge for the relief of human suffering Walter Fletcher gave richly to the common weal, and it is fitting that some worthy tribute of an enduring kind should be paid to his memory An appeal has therefore been issued over the signatures of the Lord President of the Council, the president of the Royal Society and representatives of aspects of science and medicine with which Sir Walter Fletcher was particularly associated It is considered that the tribute should consist in the first place of a personal memorial, and secondly of the inception of some scheme for the furtherance of the cause which Sir Walter Fletcher had so much at heart It is therefore proposed first to commission a portrait bust, to be placed in a suitable setting in the entrance hall of the National Institute for Medical Research, at Hampstead The remainder of the sum collected will then be used as a fund for building—at the farm premises of the National Institute at Mill Hill—a Walter Fletcher Laboratory, to be devoted particularly to those nutritional studies in which he was so keenly interested This will not only provide an appropriate memorial, but also it will make an urgently needed contribution to the national equipment for work in what is at present among the most important of all branches of medical research All subscriptions should be sent to the Secretary, Fletcher Memorial Fund, 38 Old Queen Street, Westminster, S W 1

Telford Centenary Exhibition

THOMAS TELFORD, the distinguished civil engineer, died at his house at 24 Abingdon Street, Westminster, on September 2, 1834, at the age of seventy seven years, and a few days later was buried in the nave of Westminster Abbey For the last thirteen years of his life he was president of the Institution of Civil Engineers, and in connexion with the centenary of his death the Institution has arranged an exhibition which was open for inspection at the conversazione this week and will remain open each day at 10 A M – 5 P M until June 22 The materials for the exhibition have been gathered together mainly through the efforts of Sir Alexander Gibb, whose forbears were associated with Telford in some of his works Telford's whole life was devoted to engineering works of national importance, and his steady rise from a stone mason, working on Somerset House, to the head of his profession, was due to his wide knowledge, energy and sound judgment He constructed many hundreds of miles of roads, more than a thousand bridges, some of the most important canals in Great Britain and also did valuable work on harbours His most famous works included the Ellesmere Canal with the great Pont Cysylltau Aqueduct, the wrought iron suspension bridge over the Menai Straits and St. Katherine's Docks He took the liveliest interest in the formation and growth of the Institution of Civil Engineers, presenting to it a collection of books for the formation of a library and bequeathing to it several thousands of pounds. The exhibits collected for the occasion of his centenary relate to nearly all his activities and include plans, drawings, reports, note books, letters, portraits, etc A carefully annotated catalogue has been prepared which itself forms a valuable addition to the material relating to the great engineer

History of Derbyshire Industries

THE Newcomen Society held its summer meeting in Derbyshire on June 6–9, and the members were able to pay visits to many interesting works These included the Old Crown Derby China Works, the quarries of the Clay Cross Lime Co, the hosiery works of Messrs George Brettle and Co, Ltd and the Mill Close Lead Mine, Darley Dale At various places, some interesting machines and engines were inspected and at the works of the D P Battery Co two very fine water wheels were seen After the Society's dinner on June 7, two papers were read, one on the High Peak Railway, and the other on the history of some Derbyshire industries The latter was by Mr Rhys Jenkins, who gave in it brief reviews of the lead, iron and other industries from the earliest records Lead mining and smelting was carried on in Derbyshire by the Romans, and a number of pigs of lead with Latin inscriptions have been found It is stated that there are no fewer than 4,000 disused lead mines in the county, and that some seventy years ago the output was 4,000 tons per annum The lead smelting works near Lea appear to be the last in the county Definite evidence of iron working go back to the twelfth century, and Mr Jenkins traced the development from that time onwards One interesting feature was the records of distinct industries in various localities, chains being made in one place, sickles and scythes in another, and so on About a century and a half ago, there was a flourishing industry at Hartshorn, when hundreds of gross of wood screws were made weekly. Of Lombe's famous silk mill erected two centuries ago, nothing now remains, but its erection was an outstanding event in the history of machine building

High Speed Precision Photography

AN interesting demonstration was given on June 12 of a new development in the taking and timing of serial photographs of objects moving at high speed. The apparatus, which is easily portable, is the combined work of the Western Electric Co and Kodak Limited It was demonstrated that 2,500 exposures per second could be made of objects in normal day light or illuminated with ordinary '½ watt' type lamps on the standard small size Kodak film. The interest in the camera lies in its extreme simplicity. As the film has to move across the focal plane with speeds up to 50 feet per second, the usual intermittent motion must be dispensed with and a uniform motion substituted. Mounted between the lens (Kodak anastigmat *f*/1 8) and the film is a small slab of glass which rotates about an axis parallel to its own plane and passing through the middle of the slab This gives a lateral motion to the image in the same direction as that in which the film is moving Exposure is only allowed when the slab is approximately normal to the optic axis, when the lateral speed of the image will be $\omega T\ (\mu-1)/\mu$, where T is the thickness of the slab and ω its angular velocity There is no mechanical shutter other than the mounting of the slab, which intercepts the light twice for every complete revolution, and this combined motion of film and image takes the place of the more usual motion hitherto adopted The image of a moving dial is projected on to the corner of each exposure by an accessory internal optical system The motion of the dial is controlled independently by a 200 fork controlling a synchronous motor The time spacing on the image can be read to $\frac{1}{1000}$ sec The demonstrations of muscular reaction times and of splashes were extremely good, but it was noticed that in the comparatively simple image of a falling steel ball, there was a slight elongation

International Broadcasting Union

THE International Broadcasting Union (or the Union Internationale de Radiodiffusion—to use its official title) is making its first official visit to Great Britain at the meeting which is being held in London from June 12 until June 20 The issue of *World Radio* of June 8 contains a series of articles describing the organisation and work of the Union When the Union was founded in London in March 1925, eight European countries were represented, and according to the minutes of that meeting it was estimated that the broadcasting stations in Europe at that moment radiated a total energy of 80 kilowatts, of which 43 kilowatts emanated from stations in Great Britain At the present time, in the tenth year of the Union's existence, twenty five countries have members within the Union and the radiated energy of more than 250 stations included within what is officially recognised as the European zone is about 4,250 kilowatts The particular function of the Union with which the listening public is probably most familiar is that of policing the ether'—in other words maintaining the wave lengths of stations so far as possible uninterrupted by those of other stations

THIS, however is only one of many useful and essential duties performed by the Union with the aid of commissions dealing with legal, programme relay and technical matters In the course of its work a spirit of co-operation has been established among the European broadcasting authorities as a result of their common membership of the Union, and in addition strong and valuable links have been forged with the broadcasting organisations of other continents, notably the great American chains and the corporation which controls Japanese broadcasting Moreover, the Union has striven throughout its existence to promote that good understanding between nations, which is one of broadcasting's most valuable contributions to national life Since the inception of the Union, the president of the Council has been Sir Charles Carpendale, one of the controllers of the B B C while Mr A R Burrows, a pioneer of British broadcasting, has filled the post of secretary general in a popular and efficient manner at the Geneva office of the Union

British Antarctic Expedition

SOME further details of Mr J R Rymill's forthcoming antarctic expedition are published in the *Geographical Journal* of June It is hoped to leave Great Britain early in September in the *Penola*, a three masted topsail schooner of about 200 tons with a length of 112 ft The *Penola* which is fitted with a 100 H P Diesel engine, was built in 1908, she is of oak, and is now being reconditioned and sheathed with greenheart at Southampton A De Haviland Puss Moth aeroplane, capable of carrying three men, or two men with a survey camera, is being taken Sixty dogs from West Greenland and twelve sledges will be carried Messrs Hampton and Stephenson, with the dogs and much of the equipment, will leave for the Falkland Islands in July, and Mr Rymill with the rest of the expedition sailing in the *Penola* will meet them there in October *Discovery II* is to assist in the transport of stores as far as Deception Island Beyond that, the plans of the expedition will depend on the state of the ice, but it is hoped to set up the base house on Hearst Land in order to explore east and west by sledge It may however be necessary for the ship to return to Deception Island if no good harbour is found in the far south The expedition proposes to return to England in May 1937

Jubilee of the Society of Dyers and Colourists

COMMEMORATING the foundation fifty years ago, of the Society of Dyers and Colourists a jubilee issue of the Society's *Journal* has recently been published Of the twenty two articles which it contains, some are reviews of the advances which have been achieved during that time and others deal chiefly with the present state of knowledge in various departments of the science and art of dyeing A foreword is contributed by Prof G T Morgan who as an active worker in dye chemistry and as president of the oldest chemical society in the world refers to the rise of the British colour industry and to the means whereby Parliament has safeguarded its growth Mr J Huebner contributes an interesting account of the early history of dyeing and Mr A H Brewin sketches the history of the Worshipful Company of Dyers, London Prof A G Green discusses landmarks in the evolution of the dyestuff industry during the past half century and Dr H Levinstein contributes some pertinent observations on British patent laws Articles on the constitution of cellulose by Prof W N Haworth on substitution in the benzene nucleus by Prof R Robinson, and on the relation between the constitution and substantivity of dyes by Prof P Ruggli serve as a reminder, should any be necessary, of the close dependence of a successful chemical industry on researches in 'pure' chemistry Among the other articles, no less interesting because of a technical character, are accounts of progress in various dyeing, cleaning, bleaching and finishing operations applied to textiles, furs and leather, and a review of the chemistry and technology of rubber and synthetic resins The price of the special issue is 25s , but members of the Society may purchase one copy at a privilege price

The National Physical Laboratory

THE report of the National Physical Laboratory for the year 1933 is a quarto pamphlet of 264 pages and 50 figures, many of them plates, and provided with an index of 10 pages The condition of industry has reduced the demand for routine tests of instruments and for investigation of problems of manufacture, but the research programmes of the Executive Committee and of the Boards and Committees of the Department of Scientific and Industrial Research have been pressed forward An important and promising method of bringing provincial industries into touch with the Laboratory has been tried during the year, by the senior members of the staff lecturing on the general work of the Laboratory and on specific problems of local industries at many large towns in the country Each department of the Laboratory provides its report, and each report contains matter of great interest which is well illustrated by figures and easily followed The Radiology Division has for example, investigated the effect of heat treatment on metals which have been cold worked previously, and finds that a magnet steel retains its magnetic properties better when in a state of strain than when the strain is relieved by heat treatment, and that transformer steel is the better for being free from internal strain On one hand, the Department has tested for internal flaws two Diesel engine connecting rods of 4 in diameter, and on the other, for the Medical Research Council the structure of human teeth

Quieter Motor-Cars

A RECENT report by Science Service gives a résumé of the discussions during the annual general meeting of the Society of Automotive Engineers at Detroit It was stated that in the earlier days of motoring the thrill of passing another motorist was incomplete unless your motor had a louder and deeper roar than his Now motorists are worried even by the amount of noise their tyres make Modern car mechanisms are so improved that at speeds below 40 miles an hour this noise is clearly audible In fact some motorists utilise it to keep the speed constant The low buzz or flutter is due to the trapping of air in parts of the tyres Noise in motor cars can be eliminated in two ways, either by absorption or cancellation by interference In mufflers which absorb sound, the sound energy is converted into heat by resonators owing to the friction of waves passing through small holes and the use of porous materials Mufflers that depend on wave interference get one part of the sound in opposition in phase with the other, so that they partially cancel One new type of muffler passes part of the exhaust gas through a venturi tube and it then operates the wind shield cleaner A silencer which utilises both resonance chambers and absorbing materials is sometimes effective in preventing intake noise (power roar) The noise to passengers can be considerably reduced by padding the bodies of the saloon by sound absorbing material in the same way as the acoustical properties of radio studios can be improved One result of making motor cars quieter is that the driver often unconsciously increases the speed

Venereal Disease in Literature

IN a paper on this subject read on May 30 before the Medical Society for the Study of Venereal Diseases Dr J D Rolleston said that in no department of medicine is a knowledge of the lay writers on the history of the subject more necessary than in the domain of venereal disease The information furnished by poets, dramatists novelists and historians forms a valuable supplement to that derived from the study of contemporary medical works In a survey of non medical literature from the earliest times down to the present day containing any references to the three principal venereal diseases, Dr Rolleston came to the following conclusions There is no definite evidence that syphilis existed in Biblical times, classical antiquity or the Middle Ages In striking contrast with the absence of any certain reference to the existence of syphilis in Europe before 1495 an immense amount of literature, lay as well as medical, dealing with the new disease followed that date On the other hand, gonorrhœa, of which the first description is in Leviticus, dates from remote antiquity, but for about 250 years was identified with syphilis, the popular monosyllables for the two diseases being applied indiscriminately in lay literature to syphilis or gonorrhœa Chancroid was probably as old as gonorrhœa and was well known in classical antiquity and the Middle Ages

Human Sterilisation

THE April number of the *Eugenics Review* is largely devoted to the subject of sterilisation Major Leonard Darwin makes a detailed analysis of the report of the Departmental Committee known as the Brock Report, Dr E Mapother discusses the necessary safeguards in eugenic sterilisation and Prof Hans Maier of Zurich contributes an article on practical experience of sterilisation in Switzerland where it has been practised in certain cantons under medical supervision for more than fifty years The legal aspects of sterilisation in Great Britain are discussed by Mr Cecil Binney, and Dr C C Hurst contributes a paper on the genetics of intellect An account is also given of discussions in the House of Commons, and the speech of Mr Hugh Molson, M P , in moving that H M Government give immediate consideration to the recommendations made unanimously by the Committee is reproduced in full In all cases, emphasis is laid upon the need that sterilisation should be voluntary, and with proper safeguards, as any element of compulsion defeats its own ends

Cancer Research

In March 1933 the International Cancer Research Foundation, established by Mr William H Donner of Philadelphia, awarded a sum of £1,000 per annum for a period of two years to the Research Institute of the Cancer Hospital (Free), London, in support of investigations into factors which underlie the origin of malignant growths This grant has provided two research scholarships which are held by G A D Haslewood, who is working with Dr J W Cook in the Research Institute, and by Miss Edna Roe, who is studying the molecular structure of carcinogenic compounds by physical methods, under Dr Mayneord in the Physics Section of the Radiological Department of the Cancer Hospital The grant has also defrayed a part of the cost of this work Under the direction of Dr Cook, Haslewood has recently prepared a very active cancer producing compound, methylcholanthrene, from another compound, deoxycholic acid, which is known to occur in the human body To assist in further developments of this work, the Trustees of the International Cancer Research Foundation have now decided that this grant shall be continued for an additional three years, until June 1, 1938

Ross Institute Industrial Advisory Committee

Details of the activities of this Committee in promoting health in the tropics are given in the report of a meeting held on March 27, with Mr G H Masefield in the chair As a result of health measures introduced in the copper mines of Northern Rhodesia, at Zambezi Bridge, and in the tea gardens in Assam, sickness due to malaria has been much reduced. Dr McCombie described an experiment in a tea garden with the drugs atebrin and plasmoquin as preventives of malaria, with a saving of 1,941 sick days among the coolies, but the treatment is too costly to be a business proposition (11 annas per head) On the same estate anti mosquito larval measures proved much cheaper (2 6 annas per head) and resulted in a saving of 7,068 sick-days Reference was made to the 'eye fly pest' in India and Ceylon, caused by numbers of a small fly (*Microneurum funicola*) which settle upon the eye, and by the bacteria which they carry induce ophthalmia The breeding habits of this fly have still to be discovered, but by providing infected cases with wire gauze spectacles, these epidemics may be controlled in large measure by preventing carriage of infection

Official Chemical Appointments

The Institute of Chemistry has recently issued the eighth edition of the 'List of Official Chemical Appointments" (Institute of Chemistry, 30 Russell Square, London, W C 1 1934 Price 5s) Since the seventh edition was published three years ago, much revision has been necessary, but the list is now a useful, up-to-date compendium of official appointments It consists of a list of official appointments in Great Britain, Northern Ireland and the Irish Free State, a list of appointments in the British Dominions, Colonies, Protectorates, Egypt and the Sudan Provinces, information concerning societies and institutions devoted to chemical interests, and statutes, orders, etc, which affect official chemical appointments Names of university professors, lecturers and demonstrators, and public and secondary school masters are also included There are indexes of names and places respectively A full contents, classified, and with each group arranged alphabetically, renders a general index unnecessary This is a useful list, well arranged, so that reference is an easy matter

Pollen Carried by Dust Storm

Mr O C Durham, chief botanist of the Abbott Laboratories in North Chicago, exposed collecting slides through the period of the remarkable dust storm recently experienced in the United States His collections, as a result of the examination of these slides, indicate a fall of some 34 7 tons of dust per square mile of which no less than 3 4 tons would be represented by oak pollen This percentage of pollen certainly seems a striking phenomenon and has its interest in connexion with the use made of pollen distribution in strata of vegetable remains, as an indication of the vegetation in these areas at the period when the remains were deposited Mr Durham's observations are reported by Science Service, Washington D C under date May 14

Micrometer Scales on Photomicrographs

In the May issue of *Watson's Microscope Record*, J A Lord pleads for the inclusion of a scale of measurement on each published photomicrograph, so that a visual estimate of the size of the objects represented is readily possible He also points out the desirability of including such a scale of measurement on lantern slides made from photomicrographs so that, irrespective of initial or final magnifications, the dimensions of the objects can be estimated as seen on the screen Appended to his article is a convenient form of scale by the aid of which a micrometric scale, correct for each given magnification, can quickly be marked upon a photograph or a lantern slide

Greenland Whale at the Natural History Museum

The skeleton of a Greenland whale, which has been presented by the president and council of the Royal College of Surgeons to the trustees of the British Museum, has been removed from the College and will shortly be erected in the new Whale Hall at the Natural History Museum The specimen was originally purchased by the College in 1864 from Prof Reinhardt, of Copenhagen Although the Greenland whale is commonly used as a textbook example of the Cetacea, complete skeletons of this species are very rare in museums, and in Great Britain there appears to be a record of only one other, a young one, which is in the Anatomical Museum of the University of Edinburgh

The Men of the Trees

The ninth annual report of this voluntary society, which attempts to bring together those interested in trees, their planting, cultivation and protection, shows that it is still active and growing in membership ("The Men of the Trees" Ninth Year's Report and Review of the Tree Year 1933 Pp 36+4 plates London Hon Secretary, 32 Warwick Road, S W 5 6d) Whilst the death duties cause the break up of many old well wooded estates and realisation upon their timber, the Forestry Commission still suffers under a cut of £400,000, so that its planting programme is inevitably cut down Under these conditions, there is ample room for the activities of this society, which in its ninth annual report gives an extensive account of an important statement upon the position of forestry in the Empire made at the annual meeting of the society by Prof Troup, of the Imperial Forestry Institute, Oxford

Works on Astrology and Alchemy

AN interesting catalogue of second hand books on astronomy, astrology, alchemy and the occult sciences has recently been published by Émile Offenbacher, 10 Rue Pasquier, Paris, 8^e Among the more attractive items may be noted the first Italian edition of Euclid with a commentary by Tartaglia (1543), a first edition of Galileo's Istoria e dimostrazione intorno alle macchie solari" (1613), a second edition of Reisch's Margarita philosophica" (1504), a copy of Thomas Radini s Sideralis abyssus ' (1511), and the first edition of Kertzenmacher s Alchimia" (1538) A score of books on the Rosy Cross are included and all the items appear to be very moderately priced Bibliographical notes are given in sufficient detail a feature which, with the numerous illustrations, will make the catalogue a useful book of reference even when the books it describes have found scattered homes in the libraries of collectors We hope that M Offenbacher will give us further catalogues of the same kind, for they represent a real contribution to the history of science

Announcements

THE Albert Medal of the Royal Society of Arts for 1934 has been awarded to Sir Frederick Gowland Hopkins, president of the Royal Society, for his researches in biochemistry and the constituents of foods The medal is awarded annually for distinguished merit in promoting arts, manufactures, or commerce

PROF A C SEWARD, professor of botany in the University of Cambridge, has been elected a foreign member of the Botany Class of the Royal Swedish Academy of Sciences

SIR FREDERICK GOWLAND HOPKINS will unveil a plaque to William Hyde Wollaston at 14 Buckingham Street, W 1 on Wednesday, July 4, at 3 30 p m

PROF P L MERCANTON, professor of meteorology and geophysics in the University of Lausanne, has been appointed director of the Central Meteorological Station of the Commission fédérale suisse de Météorologie, in succession to Dr J Maurer, who has recently retired

THE following appointments in the Colonial agricultural service have been made by the Secretary of State for the Colonies Mr A K Briant, to be agricultural superintendent, St Vincent , Mr. M Halcrow, to be agricultural officer, Kenya , Mr N M Wight, to be district agricultural officer Tanganyika , Mr H W Jack (economic botanist Federated Malay States), to be director of agriculture, Fiji , Mr F L Squibbs (assistant agricultural officer Dominica), to be director of agriculture, Seychelles

IT is announced in the *Times* of June 9 that the Belgian National Scientific Research Fund has made a grant of 750,000 francs (more than £7,100) for the erection in Brussels of the Albert Library in memory of the late King of the Belgians The Société Financière Mutuelle Solvay has subscribed 500,000 francs

ADVISORY leaflets on matters of interest to farmers recently issued by the Ministry of Agriculture and Fisheries, include one on the use of seaweed as manure, pointing out its special value for crops which require a large amount of potash and are benefited by salt Other leaflets deal with birds of agricultural significance (more or less) , they include the kestrel, landrail and nightjar Another describes the activities, life history and control of the turnip gall weevil

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A principal of the Municipal Technical College Halifax—The Education Officer Education Offices West House Halifax (June 18) An assistant master to teach surveying and general science at the Pontardawe Mining and Technical Institute—The Director of Education County Hall Cardiff (June 18) A teacher of botany and chemistry at the Ashford and Folkestone Technical Institutes—The Principal, Technical Institute, Ashford (June 22) A lecturer in chemistry at Chesterfield Technical College—The Clerk to the Governors, Technical College, Infirmary Road, Chesterfield (June 23) A City electrical engineer for Plymouth—The Town Clerk, Municipal Buildings Plymouth (June 25) A mining instructor at the County Secondary School and Cumberland Technical College, Workington—The Principal (June 23) A teacher of general chemistry at the Northern Polytechnic, Holloway, London, N 7—The Clerk (June 27) A veterinary officer to the County Borough of Wallasey—The Town Clerk, Town Hall, Wallasey (June 28) A junior lecturer in electrical engineering at the Military College of Science, Red Barracks, Woolwich, S E 18—The Commandant (June 30) A district agricultural organiser for the East Anglian Institute of Agriculture, Chelmsford—The Clerk of the Council, County Hall, Chelmsford (July 2) An assistant lecturer in anatomy and an assistant lecturer in physiology at the University College of South Wales and Monmouthshire, Cardiff—The Registrar (July 7) A teacher of domestic science at the Princess Mary's Village Homes (Home Office Approved' School), Addlestone, Surrey—The Secretary An assistant lecturer in mathematics at University College, Hull—The Registrar A second assistant port engineer to the Basrah Port Directorate, Iraq—The Crown Agents for the Colonies, 4, Millbank, London, S W 1

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*]

The Factor $\frac{137}{136}$ in Quantum Theory

IT has been suggested by W N Bond[1] that in some or all of the attempts to determine e/m experimentally, *the quantity actually found is* $\frac{136}{137}$ e/m, for if the experimental results are corrected in accordance with this hypothesis they are found to be in satisfactory accordance with my theoretical values of the fine structure constant (137) and mass ratio (1847 6) R T Birge[2] has confirmed this and, quoting three important recent determinations of e/m, he has shown that the agreement is extremely close

On theoretical grounds it seems likely that Bond s hypothesis is right In my earliest paper on the subject[3], I gave the value of the fine structure constant as 136, since I found the Coulomb energy of two elementary particles to be $1/136r$ in natural quantum units This energy was $\frac{137}{136}$ times too large, because I had not allowed for the 137th degree of freedom arising from the indistinguishability of the particles *Bond s hypothesis implies that I am not the only victim of this mistake*, current quantum theory in deriving from observational data the proper energy or *mass m* of an electron has also obtained an energy $\frac{137}{136}$ times too large If so the cause is presumably the same namely neglect to take into account the degree of freedom due to indistinguishability

There is nothing mystical in the effect of indistinguishability It occasions, not an objective difference of behaviour, but a difference in what we can ascertain about the behaviour and hence a difference of treatment In the dynamics of two particles we have to describe the change with time of the positions, momenta and spin components (or of a probability distribution of them) of the particles which we call No 1 and No 2, and also we have to describe a growing uncertainty whether the particle, called No 1 at the time t is the original No 1 If the probability that it is the original No 1 is $\cos^2\theta$ (so that the probability that it is the original No 2 is $\sin^2\theta$) the permutation variable θ will be a function of the time and have all the properties of a dynamical variable, giving therefore an extra degree of freedom of the system and having a momentum (energy of interchange) associated with it When, however, the particles are distinguished without uncertainty, θ is constrained to be zero, and this degree of freedom is lost

Thus for the treatment of two indistinguishable particles, we have to start with an *a priori* probability distributed over a closed domain of 137 dimensions, whereas for two distinguishable particles it is distributed over a closed domain of 136 dimensions Naturally, the average values of characteristics of the distribution are slightly different in the two treatments In particular, the energy tensor of the *a priori* probability distribution, which is identical with the metrical tensor $g_{\mu\nu}$ of macroscopic theory is different Hence *the two kinds of treatment are associated with different metrics of space time* It seems clear that a factor $\frac{137}{136}$ (neglected in current quantum theory) will be introduced by the change of metric when we equate the space occupied by the indistinguishable particles of quantum theory to the space occupied by the distinguishable parts of our measuring apparatus

It may be asked Why does this factor affect the mass of the electron but not that of the proton ? The discrimination is, I think not strictly between the proton and electron but between the resultant mass ($M + m$) which is nearly the mass of a proton, and the reduced mass of the relative motion $Mm/(M + m)$ which is nearly the mass of an electron, for it is in the relative motion that the question of distinguishing the two ends of the relation arises It may also be asked why the factor $\frac{137}{136}$ which refers especially to a system of two particles, applies irrespective of the number of particles The answer is that the metrical ideas of quantum theory are borrowed from those of relativity theory, and since the latter are based on the interval between two points the former refer correspondingly to the wave function of two particles

A S EDDINGTON

Observatory, Cambridge
June 5

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[1] W N Bond NATURE 133 327 March 3 1934
[2] R T Birge NATURE 133 648 April 28 1934
[3] A S Eddington *Proc Roy Soc* A 122, 358 1929

Production of Very Low Temperatures by the Magnetic Method Supraconductivity of Cadmium

A YEAR ago the first experiments for producing very low temperatures by adiabatic demagnetisation of certain paramagnetic substances, as suggested by Debye[1] and Giauque[2] were carried out, by Giauque and MacDougall[3], and also by de Haas Wiersma and Kramers[4] Continuing our former experiments[5] on the magnetic method we have constructed an apparatus for investigations in the region of lowest temperatures As we shall soon give a detailed report of some calculations and experimental work, we will mention here only some of our results

We succeeded in so choosing the conditions that, on one hand, the removal of the heat of magnetisation was completed in a few minutes, on the other hand the condensation of the residual gas on the cooled substance took place very rapidly, the latter being necessary for keeping the low temperatures attained Hence one had to keep the magnet switched on only for a few minutes

Using 0 5 gm of manganese ammonium sulphate, a substance we found to be most suitable, we reached 0 1°, starting at 1° and 6,000 gauss (a stronger magnet was not at our disposal) The temperature was determined by measuring the susceptibilities and extrapolating as in the experiments mentioned above, this procedure being subject to the same objections as discussed there The thermal insulation in our arrangement was such that it took, for example, one hour and a half to warm up from 0 18° to 0 26°

We then made experiments in cooling down other substances with the paramagnetic salt, looking first *for supraconductivity in the case of cadmium* For this purpose a tablet was pressed out of equal volumes of cadmium and manganese ammonium sulphate

The experiments showed that cadmium becomes supraconductive This was recognised by the appearance of persistent currents, a method of observation similar to that used by Tuyn and Kamerlingh Onnes[6] in investigating powdered substances The same mutual inductance, which served for the measurement of the susceptibility of the salt, was used to detect these persistent currents Extrapolation to zero measuring field gives a transition point of about 0 6°

N KÜRTI
F SIMON

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June 3

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[1] P Debye *Ann Phys* 81 1154 1926
[2] W F Giauque *J Amer Chem. Soc* 49 1864 1927
[3] W F Giauque and D P MacDougall, *Phys Rev* 43 768, 1933 44, 235, 1933
[4] W J de Haas E C Wiersma and H A Kramers, *Physica*, 13, 175, 1933 1 1, 1933
[5] N Kürti and F Simon, *Naturwiss* 21 178 1933 N Kürti *Z phys Chem.* B 20, 305 1933
[6] W Tuyn and H Kamerlingh Onnes *Leiden Comm* 181

Phase Variations of Reflected Radio-Waves, and a Possible Connexion with the Earth's Magnetic Field in the Ionosphere

THE apparatus used for measuring the phase variations of the reflected radio waves, already described[1] consists of a transmitter modulated by the alternating 42 cycle current to emit periodic signals of, say 1/1000 sec duration The receiver consists of a one stage screen grid high frequency amplifier a plate circuit detector and a final one stage continuous current amplifier The observations are made by a cathode ray oscillograph the spot of which is deflected along the time axis by the same alternating current The detector valve is made to oscillate at a frequency little different from that of the transmitter, then beat curves are observed on the oscillograms corresponding to the reflected wave trains

The position of the beat curve is a measure of the virtual height of reflection Moreover when the echoes do not present phase variations (optical path constant), the beat curves are absolutely fixed, this is due to the fact that the oscillating detector is synchronous with the transmitter at the beginning of the emission of the signal When the phase of the reflected waves changes (by variation of the optical path), the beat curves present an apparent movement, from which, as in an interferometer it is possible to determine the velocity and the sense of the optical path variation (For an optical path change of even a fraction of a wave length the modification of the beat curve is easily visible) When the ionic density increases, the optical path diminishes, and inversely

The most interesting phenomenon that I have observed is that the two echoes produced by the magneto ionic double refraction sometimes present phase variations of opposite sense This can be explained, in the present state of our knowledge, only by admitting a variation of separation of the two echoes, possibly following a change of intensity of the earth's magnetic field in the ionosphere Whatever effects the change of ionic density, it causes optical path variations in the same sense for the two echoes In correspondence with the periods during which I have observed phenomena of this type, even the magnetic field at the earth's surface shows remarkable variations

Researches are in progress to investigate further the relationship between such variations in the ionosphere and magnetic conditions at the earth's surface

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May 22

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[1] *Nuovo Cimento* p 258, 1931 *Rend Accad Lincei*, 16, 40 1932 NATURE, 132 174 July 29 1933

Radio Exploration of the Ionosphere

PROF APPLETON'S recent letter[1], reporting the measurement of the magnetic intensity *H* in the upper ionised region of the atmosphere, illustrates anew the power and value of radio methods of upper air investigation It affords clear evidence, which probably few workers on the earth's magnetism expected ever to gain of the decrease of the field with height This decrease is predicted by the Gaussian potential theory but not without some small uncertainty due to the slight non uniformity of the earth's magnetisation, and also to the existence of electric currents in (and perhaps beyond) the atmosphere

Should it become possible to determine *H* by radio methods to within 1 per cent, the results may afford a check on the magnetic theory provided that we know also the height to which the measures refer At present there is difficulty in interpreting the equivalent heights' attained by radio waves and therefore the immediate value of Prof Appleton's measures of *H* may lie chiefly in the independent estimate of height which they afford by inference from magnetic theory In the latitude of Great Britain and except in periods of notable magnetic disturbance the theory seems quite adequate for this purpose Nearer to the auroral zone, however, where the upper air electric currents are both more powerful and more localised the radio measurements of *H* may become of great value in mapping the magnetic field

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May 31

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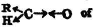
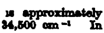
[1] NATURE 133, 793 May 26 1934

Absorption Spectra of Aldehydes

1 RECENT observations of the ultra violet absorption bands in the vapours of a series of homologous aldehydes have disclosed a vibrational structure, which is very similar throughout the series, since 35 measurements have given an average separation of 1025 cm^{-1} in the spectra of the higher homologues, although this interval increases to 1053 cm^{-1} in acetaldehyde The corresponding frequency 1187 cm^{-1} in formaldehyde has been attributed to a nuclear vibration of the excited molecule  $\genfrac{}{}{0pt}{}{H\nwarrow}{H\swarrow}\!\!>\!C\rightarrow\;\leftarrow O$, and there can be little doubt that we are now dealing with a similar nuclear vibration  $\genfrac{}{}{0pt}{}{R\nwarrow}{H\swarrow}\!\!>\!C\rightarrow\leftarrow O$ of the other aldehydes

2 The maximum absorption is approximately constant at about 2900 A or 34,500 cm^{-1} In

the case of formaldehyde this electronic excitation has been shown unambiguously by Dieke and Kistiakowsky[1] to be associated with a change of electric moment in the y plane that is perpendicular to the C=O axis and in the plane of the two hydrogen atoms The excitation of the other aldehydes may be presumed to proceed in the same way Mulliken[2] has pointed out that such an electronic transition will appreciably affect the C–H bonds a conclusion which Norrish[3] had reached previously on chemical grounds

3 These considerations may be extended to the ketones $^{R^1}_{R^2}{>}C=O$ where our own preliminary observations on acetone showed ill-defined separations of about 1100 cm^{-1} The separations described by Bowen and Thompson[4] are twice as large and irregular in magnitude moreover the frequency 2900 cm^{-1} of the Raman line with which they compare these separations is characteristic of valency vibrations involving hydrogen atoms rather than those postulated under (1) above It is therefore clear that further confirmation is required before these larger separations can be accepted as characteristic of the >C=O group

4 Striking results have been obtained with acrolein which (through the kindness of Prof W L Bragg) we have examined with the 21 foot grating at Manchester In all other aldehydes except formaldehyde the fine structure is either too complex to be analysed at present or too diffuse to be recorded in detail The absorption spectrum of acrolein however shows several bands which have a fine structure rivalling those of the diatomic gases in simplicity and sharpness These bands consist of sharp regularly spaced lines of which as many as 20 may be seen in a range of less than 20 A They resemble the rotational lines of the R branch of a diatomic molecule but they present a remarkable anomaly which does not appear to have been observed previously since the moment of inertia of the ground state calculated on the assumption that the lines constitute single rotational series is different for the various bands instead of being constant throughout

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May 6

Phys Rev 45 4 1934
[2] Private communication
[3] *Trans Farad Soc* 28, 391 1931
[4] NATURE 133 571 April 14 1934

Relation of Materials of the Cell Nucleus to the Lethal Action of Ultra-Violet Radiation

SEVERAL workers have suggested the possible relationship of materials of the cell nucleus to the lethal action of ultra violet radiation[1–4] but there seems to have been no systematic study of the problem heretofore

The lethal action of such radiation for cell life has been found to begin abruptly at about 2950 A and to continue for shorter wave lengths[5–11] By exposing such materials as thymus nucleic acid adenine uracil etc to ultra violet radiation through various long wave pass filters and studying their absorption before and after irradiation we have found 2950 A to be approximately the longest wave length effective in their destruction

Absorption studies of uracil[12] etc, in concentrations approximately that in which these substances appear in the cell nucleus show them to have marked absorption in the ultra violet shorter than 2900 A The long wave leg of the absorption band rises steeply between 3000 A and 2900 A its position agreeing closely with the wave length threshold for the lethal action of ultra violet radiation on bacteria

Finally thymus nucleic acid yeast nucleic acid etc have been found to have marked absorption maxima at about 2600 A[12 13] This agrees quite closely with the optimum wave length region for the lethal action of ultra violet as found by various workers[8 9 11 14–17]

These three types of results indicate that materials of the cell nucleus play an important part in the lethal action of ultra violet for at least many kinds of micro-organisms

When the rays shorter than about 2900 A are filtered out the irradiation of nuclear compounds has been found to bring about absorption changes indicative of the formation of isomers or more complex compounds The possibility that these products of long wave irradiation may be growth promoting or cell division promoting is being investigated

Full details of these experiments will be published elsewhere

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May 7

Mme Victor Henri *C R* 158, 1032 1914
[2] Galeotti *Ann Inst Pasteur* 30 49, 1916
[3] Bovie and Hughes, *J Med Res* 39 223 1918
[4] Gates *Science*, 68 479, 1928
Barnard and Morgan *Brit Med J*, 1269 1903
[6] Henri and Schnitzler, *C R*, 149 312 1909
Cernovodeanu and Henri *C R* 158 1032 1914
[8] Newcomer *J Expt Med* 26 841 1917
[9] Browning and Russ, *Proc Roy Soc B* 90 33 1917
[10] Burger *Bull Bas Sci Res* 3 46 1928
Meier *Smithsonian Miscellaneous Collections* 87, 1932
[12] Heyroth and Loofbourow *J Amer Chem Soc* 53, 3441 1931
[13] Heyroth and Loofbourow, in publication
[14] Gates *J Gen Physiol*, 14 31, 1931
Bang *Mitteilungen aus Finsen's Med Lysinstitut* 9 164 1905
[16] Weinstein *J Opt Soc Amer* 433 1930
Loofbourow and Cameron *Bull Bas Sci Res* in publication

Hæmorrhages in Chicks Reared on Artificial Diets a New Deficiency Disease

DURING work on the sterol metabolism of chicks[1 2] it was observed that the animals often exhibited extensive internal hæmorrhages when they were fed a ration consisting of vitamin A free casein 20 Marmite 10 salt mixture 4 5 starch 65 5 and varying amounts of cod liver oil concentrates The hæmorrhages were subcutaneous or intramuscular on the breast legs and wings and were accompanied by certain pathological changes in the horny stratum of the gizzard

The disease closely resembles scurvy but it has been shown that vitamin C either in the form of lemon juice (up to 77 c c in 59 days) or pure ascorbic acid (given by mouth or subcutaneously) in very large doses was without the slightest influence on the occurrence of the symptoms It has nothing to do with lack of vitamin A D B_1 B_2 fat or cholesterol

When chicks are fed a ration consisting entirely of cereals or seeds plus salts, the hæmorrhages fail to occur The cause of the disease must therefore be a *deficiency in an antihæmorrhagic factor different from vitamin C and occurring in cereals and seeds*

The histological features of the symptoms as well as the concentration and further characterisation of the antihæmorrhagic factor are being investigated further

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May 2

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[1] H Dam *Biochem Z* 215 485 1929
[2] H Dam *Biochem Z* 220 159 1930

Optical Rotatory Power

AN interesting mathematical derivation of the rotatory power of a simple organic compound has just been published by S F Boys[1] from which conclusions are drawn regarding *inter alia* the influence of solvents upon the magnitude of the rotation The author s comments on the effects of association and his classification of active solutes into three main groups namely non polar polar and those capable of entering into co ordination or complex union with the solvent are in agreement with the views arrived at by one of us from experimental data[2]

We are at present engaged in investigating the behaviour of optically active saturated hydrocarbons towards change of solvent using *d* pinane methyl menthane and other compounds as the non polar solutes We find that the rotation in such cases is chiefly governed by the refractive index of the solvent medium This point is illustrated by the following values for *d* pinane in dilute solution

d Pinane in Solution ($c = 3\ 5$)

Solvent	n_D	$[\alpha]_D$	Solvent	n_D	$[\alpha]_D$
Acetonitrile	1 3460	+18 7°	Methylene dichloride	1 4237	+21·0
Methyl alcohol	1 3312	19 3	Heptane	1 3867	21 1
Acetic acid	1 3715	19 5	Chloroform	1 4464	21 8
Nitromethane	1 3813	19 8	Carbon tetrachloride	1 4607	22 9
Acetaldehyde	1 3316	20 1	Methyl iodide	1 5293	23 6
Hexane	1 3760	20 1	Methylene iodide	1 7559	26 6
Acetone	1 3589	20 9	Carbon disulphide	1 6204	28 1

A large number of aromatic solvents have also been examined which fall into their appropriate positions in the above table The refractive indices quoted are those of the pure solvent but the results strongly support the prediction of S F Boys that the rotation of non polar solutes will be dependent on the refractivity of the solution An interesting point is that the specific rotation of pinane in the homogeneous state (n_D 1 4624 $[\alpha]_D + 22\ 95°$) is practically unaltered when the compound is dissolved in carbon tetrachloride (see table) In this case solvent and solute have almost identical refractive indices

Similar results are being obtained with other hydrocarbons full details of which will be published later

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May 16

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[1] *Proc Roy Soc* A 144, 655 675 1934
[2] Rule and co-workers, *J Chem. Soc* 384 1217 1933 and earlier papers

Raman Spectra of Benzene and Hydrogen Iodide in the Liquid and Solid State

A SYSTEMATIC investigation at low temperatures of the oscillation and rotation Raman spectra of simple molecules as they are affected by their state of aggregation and by temperature seems to us of great importance, for the transition from the gaseous to the liquid state will show mainly the influence of density, while in the transition from the liquid to the solid state the orientation of the exchange forces due to the crystal structure may have some influence on the Raman lines Moreover having ascertained the dependence of the Raman spectra upon temperature we are in the position to say something about the magnitude of the exchange forces and the rotation of the molecules in the crystal

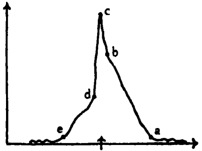

FIG 1

The whole investigation makes the utmost demands upon the low temperature apparatus as well as upon the spectroscopic arrangement We have constructed a low temperature apparatus which enables us to prepare a clear and transparent crystal and to keep it at a constant temperature (±0 1° C) between +30° and −150° C for any length of time (up to 100 hours) the type of spectrograph used is the big Steinheil with three glass prisms In order to get the best possible results from it we have increased the rigidity of its mechanical parts and have regulated the temperature of the room As source of light we employed the line λ 3888 A from a helium discharge tube to avoid any disturbance by a continuous back ground (for the details of the apparatus see the paper shortly to appear in *Z phys Chem* (B)) The following are data for the spectrograph dispersion at λ 4200 A small camera ($f = 270$ mm) 21 A/mm, large camera ($f = 650$ mm) 8 7 A/mm, diameter of the camera lens 65 mm

We have obtained the following results

Benzene

ν_R (cm) for liquid	992 2	983 3	1176 7	1605 3
ν_R (cm) for solid	990 5	982 3	1174 7	1602·9
Decrease (in wave numbers)	1·7	1 0	2 0	2 4
Decrease (per thousand)	1 7	1 0	1 7	1 5

There is thus a small decrease in the wave numbers if we go from the liquid to the solid state This change which is much larger than the uncertainty of ν_R (not more than 0 1–0 3 per thousand) means a small weakening of the binding forces of benzene in the solid state The half width of the line 992 2 cm^{-1} will be less than 4 cm^{-1} in accordance to Grassmann[1]

Hydrogen Iodide

Gaseous state[2]	2233 cm.$^{-1}$
Liquid	2164 9 ± 1·0 cm^{-1}
Decrease	68 1 cm^{-1}
Decrease per thousand	31
Solid state	2159 9 ± 1·0 cm.$^{-1}$
Decrease	5·0 cm.$^{-1}$
Decrease per thousand	2 3

For liquid hydrogen iodide we find a Raman line of a very diffuse character As in the case[2] of hydrogen chloride and bromide it has a complex structure The wave numbers in the liquid and solid state as compared with the gaseous state are given in the accompanying table The structure of the line in the liquid may be seen from Fig 1 The points marked on the curve have the following wave numbers *a* 2178 cm^{-1} *b* 2167 cm^{-1}; *c* 2165 cm^{-1} *d* 2162 5 cm^{-1} *e* 2151 cm^{-1} It may be emphasised that the structure and the wave numbers are not very accurately known

From these results it will be seen that although the low temperature apparatus already used is quite adequate for our purpose a spectrograph of higher dispersion will be necessary if we are to carry this investigation further We have therefore begun to construct a new type of spectrograph with a liquid prism

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Grassmann *Z Phys* 82, 767 1933
E O Salant and A Sandow *Phys Rev* 37 373 1931 E O Salant and D Callihan *Phys Rev* 43 590 1933

Magnetic Moment of the Deuton

IN a previous note[1] we reported together with Mr Frisch on experiments concerning the deflection of a beam of ordinary hydrogen molecules in an inhomogeneous magnetic field From these experiments we were able to derive the magnetic moment of the proton The value obtained was 2 5 nuclear magnetons (not 1 as expected theoretically)

We have now performed similar experiments with a beam of heavy hydrogen molecules and derived in a similar way the magnetic moment of the deuton The value obtained is about 0 7 nuclear magnetons[2]

A detailed account of these experiments will appear in the *Physical Review*

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May 10

NATURE, 132 169 July 29 1933
[2] The value given in the *Bulletin of the American Physical Society* (vol 9 p 29 1934 No 2) is wrong due to an error in the calculations

Electron Microscopy of Biological Objects

IN a recent paper Ruska demonstrated experimentally the possibility of surpassing considerably the resolving power of an ordinary microscope by the use of an electron microscope This high resolving power cannot be applied in biological research however without developing a new histological technique to prevent the destruction of the organic cells by the intense electronic bombardment

To overcome this difficulty it seems that there are the following possibilities

(1) Intense cooling of the object (for example by contact with an extremely thin metal foil which is cooled by conduction)
(2) Impregnating the object with a substance which makes the object less destructible
(3) Impregnating the object in such a way that a framework of the object is preserved although the object itself is destroyed
(4) Combining methods (1) and (2) or (1) and (3)

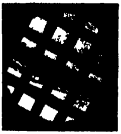

FIG 1 × 65

We obtained the best results by using the third method To arrive at good results by this method the following conditions must be satisfied by the metallic or other framework It must be (*a*) geometrically similar to the object (*b*) of high melting point and good thermal conductivity and (*c*) of high atomic weight

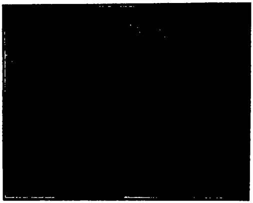

FIG 2 × about 450

Figs 1 and 2 show the results we obtained They represent a 15 μ section of a *Drosera intermedia* leaf on a copper net Fig 1 is enlarged 65 times and Fig 2 about 450 times The resolving power can be estimated from the sharpness of the border of the copper wire it corresponds to about 1 μ The microscopic object was impregnated with osmium as is done in the usual microscopy From the above photographs it seems that the osmium impregnation method can be applied—perhaps with some modifications—to electron microscopy

The photomicrographs were taken with an electron microscope of the magnetic type the description of which will be published later

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May 7

[1] Ruska *Z Phys.* 87 580 1934

Strength of Metal Single Crystals

In the course of some experimental work on single crystals of cadmium, which I have been carrying out under Prof E N da C Andrade, I have found that the condition of the surface exercises a surprisingly large effect on the initial strength of the crystal It is well known that glide commences in a single crystal when the shear stress on the glide plane, and in the glide direction, reaches a certain value known as the critical shear stress Thus in a series of crystals grown from cadmium (glide plane, hexagonal base, glide direction, axis of digonal symmetry), which proved to contain 0 15 per cent of lead and 0 15 per cent of zinc, this critical shear stress lay within the comparatively narrow range of 50–59 gm wt per sq mm, while the angles which the hexagonal planes made with the axis of the wire varied from 8° to 72°

When the crystals are grown in the presence of oxygen, there is a marked increase in the resistance to shear, values as high as 120 gm wt per sq mm being obtained As neither nitrogen, carbon dioxide nor water vapour produces a similar effect, the increased resistance to shear is attributed to a film of oxide formed on the surface of the metal Oxidation of the wires subsequent to their conversion into single crystals has the same effect, and even keeping the wires in a damp atmosphere at room temperature for several weeks produces a measurable effect Removal of the oxide film by brushing the surface with dilute sulphuric acid reduces the critical shear stress to the normal value of about 60 gm wt per sq mm

The effect cannot be attributed to any strength of the oxide film, since, first, there are considerations to show that it can only be a few atoms thick, and, secondly, there is a growth of the resistance to shear as deformation proceeds, and not the weakening which must ensue on rupture of the oxide film if its tensile strength were in question

To eliminate the effect of impurities, and of surface film, cadmium was carefully purified by sublimation *in vacuo*, which left no lead that could be detected and less than 0 1 per cent of zinc, and oxide free crystals were grown from it A single crystal prepared in this way showed a critical shear stress of only 13 7 gm wt per sq mm This seems to confirm the hypothesis of Haase and Schmidt[1] that crystals of perfectly pure metal would be unable to withstand even the smallest shear stress It may be noted that A W Hanson[2] has just published some results for very pure zinc, which bring the critical shear stress down to 9 1 gm wt per sq mm, but he does not refer to any influence of surface factors

It seems clear, then, that the ideal metal lattice has very little or no strength, slip starting at the surface and proceeding inwards, and that surface films of a certain character can prevent initiation of slip, and so greatly strengthen the crystal The analogy offered by the behaviour of rock salt, where the surface is of such significance, as evidenced by the behaviour under water, will readily occur

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May 11

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[1] *Z Phys*, 33, 413 1925 See also H J Gough, D Hanson, and J J Wright, *Phil Trans* A, 226, 1 1924

[2] *Phys Rev* 45, 324 1934

Zostera Disease on the Coast of County Cork, I.F.S

In view of the widespread effects of *Zostera* (sea grass and eel-grass) disease and the interest which it has aroused, the following brief note appears to be worthy of publication *Zostera* was first noticed to be affected by some sort of trouble in Castle Haven during the summer of 1932, when the extensive meadows near and north of Castletownshend were much less luxuriant than usual (Just off Castletownshend the plants are usually extremely robust and of great length) By the summer of 1933 the meadows had vanished At Lough Ine the various beds were unaffected until late in 1933 By December those in fairly deep water between the Coosh and the mainland, in the southern region of Barloge Creek and the two large meadows in Southern's Bay just below the Rapids, which are exposed at very low water, were very worn in appearance By the middle of February this year they had disappeared as had those which formerly all but covered the floor of the inner part of the Goleen, except for their dead remains At the end of March it was found that a further bed had completely disappeared from the Ballyally side of the Coosh By this time new growth had started in the Goleen and very soon became vigorous, whilst by the end of April there was strong growth over large areas in Barloge Creek, but no sign of any in Southern's Bay

Three chief points of interest emerge from these observations the disease seems to be spreading very slowly along the south coast of Ireland, having taken two years to travel the six miles which separate Castle Haven from Barloge Creek recovery has been extremely rapid *Z marina*, *Z nana* and the hybrid were equally affected and have made equally rapid recoveries All three occur in the Goleen, *marina* alone in the other localities I am told that at Castle Haven there has been no recovery but a simultaneous decrease in flatfish

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May 22

Control of Chromatophores in *Leander serratus*

The phenomena of colour-change in prawns are well known[1,2], and the mechanisms controlling these phenomena understood in the main[2,3] Certain details, however, require further explanation, and among them are the following —

It is stated[3] that for *Palæmonetes varians*, a form very similar to *Leander*, the effect of (*a*) darkness and (*b*) light on a white background, is the same, red and yellow chromatophores contract and reflecting yellow chromatophores expand The reverse condition is produced by light on a dark background

I find that in *Leander*, conditions (*a*) and (*b*) produce similar but not identical effects The reflecting yellow chromatophores, fairly numerous in *Leander*, do not expand and contract automatically in a reverse direction to red and yellow types (which are under hormone control) but behave independently and according to light intensity Thus, irrespective of the background, they expand in good light and contract in dim light or in darkness They also continue to do this in eyeless animals where the red and yellow chromatophores are no longer under control. It is already known[2,4] that in certain

Crustacea there is a primary direct action of light on the chromatophores as well as a secondary action through the eyes, and this primary action undoubtedly plays a part in the colour-change of *Leander*

A further difference shown by animals in conditions (*a*) and (*b*) respectively lies in the behaviour of the deep seated chromatophores In light these are expanded, so that the course of nerve cord and dorsal blood-vessel, round which many are located, can be plainly seen, and the animal appears translucent In darkness these chromatophores are contracted, and the animal appears opaque

Again, there is a very marked difference in the position of eye pigments in animals in conditions (*a*) and (*b*) In darkness the eye looks black and has an enormous pupil in light on a white background it shows a black core and pale margin, while in light on a dark background it looks black all over and shows no pupil

Thus darkness, and light combined with white background, produce different results on the eyes and on certain of the chromatophores of *Leander* Light, however, is not the only factor that can affect the chromatophores, for a considerable expansion of red and yellow types may result from excitement or muscular activity

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May 19

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[1] Keeble and Gamble *Phil Trans Roy Soc* B 196 295 1904
[2] Perkins *J Exp Zool*, 50 71 1928
[3] Koller *Z vergl Physiol* 12, 633 1930
[4] Stephenson, NATURE 130, 931 Dec 17 1932

Occurrence of an Enteropneust in Wales

A SMALL Enteropneust was found by us while shore collecting on the Anglesey coast of the Menai Straits at the beginning of April 1934 Since then we have obtained a number of specimens from this locality. The animals live in clean sand near the low water mark of spring tides at depths down to nine inches They were found in association with ***Arenicola marina***, ***Ensis ensis***, ***Echinocardium cordatum*** and ***Ammodytes***

Its identification as a species of *Dolichoglossus* is justified by the absence of an appendix to the stomochord, of synapticulæ between the gill bars, of genital wings and liver diverticulæ, and the presence of a well-developed ventral non branchial part of the pharynx, of relatively large ova in the ovaries of female specimens, of an elongated proboscis and of a single proboscis pore on the left side

The records of occurrence of adult Enteropneusts around the coasts of the British Islands are few, although there is a number of records of the occurrence of *Tornaria* larvæ A fragment of a large *Balanoglossus* sp was obtained in 1900 on the Galway coast and Tattersall obtained several specimens of a species of *Dolichoglossus*, which he named *D ruber*, near extreme low tide mark off Coastguard Point, Ballynakill Harbour, Co Galway[1] Assheton[2] obtained specimens of *Dolichoglossus* in the littoral zone at Aros in the Sound of Mull, off the west coast of Scotland in 1907, which proved to be a new species, *D serpentinus* Since then Meek[3] has recorded a single specimen of *Glossobalanus*, dredged near the Farne Islands, off the coast of Northumberland, which he named *G marginatus* So far as we are aware this is the first record of the occurrence of adult Enteropneusts on the coast of Wales and the fifth for the British Isles

Although our specimens appear to differ in coloration from *D ruber*, Tattersall, and in external proportions from *D serpentinus*, Assheton, some time must elapse before we can determine whether it belongs to either of these species So far, the internal anatomy of neither *D ruber* nor *D serpentinus* has been described in detail

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[1] W M Tattersall Ann Rep Fish Ireland 1902-3 Pt II, App VII 1905
[2] R Assheton *Zool Anz*, 33 1908
[3] A Meek *Q J Micro Soc* 66 1922

The Theory of Two Factors versus the Sampling Theory of Mental Ability

DR WILLIAM BROWN has published in NATURE of May 12 a communication on 'The Theory of Two Factors versus the Sampling Theory of Mental Ability" The matter is too involved to be discussed adequately in a letter, but I wish to record that I do not agree that this otherwise very valuable experiment is an *experimentum crucis* between my views and those of Prof Spearman, partly because I do not think Dr Mackie's formulæ are applicable in this way, but mainly because the tetrad differences had been trimmed down to the narrow scatter shown, by the choice of tests, by the rejection of one of those originally chosen, by the rejection of one of the remaining correlation coefficients, and by the elimination by partial correlation of a large group factor It is not in dispute that by these means a set of tests can be arrived at which give zero tetrads within the limits of sampling error and can then be described by a parameter *g* and as many parameters *s* as there are tests I would like to add that I admire and value the work done by Dr Brown and Dr Stephenson in arriving at the present series of tests

GODFREY H THOMSON

The University, Edinburgh
May 19

Distribution of Separates of Certain Papers by the late Dr. Bashford Dean

THERE have been placed in my hands, by Mrs Bashford Dean, for distribution among students of fishes, certain reprints of Dr Dean's studies on the archaic fishes, found among his effects after his untimely death

If research men who are interested in the morphology, anatomy and embryology of the cyclostomes, sharks and ganoids will go through Dr Dean's bibliography either in vol 1 of the "Bibliography of Fishes" or in Art 1 of the Bashford Dean Memorial Volume, and will indicate to me what articles they desire, I will forward these so far as they are available

It may be some time before the actual sending out can be done, but I should like to have all requests in before the distribution is begun.

E W GUDGER

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New York, N Y.

Research Items

Bride-Wealth in a Tanganyika Tribe The function of bride wealth, the handing over of property to the parents of the bride, among the Wabena of the Ulanga Valley is discussed by A T and G M Culwick in *Africa*, 7, No 2 The manner of complying with the custom is subject to wide variation, which suggests that features belonging to mother right and father right exist side by side In former days, bride wealth consisted of three hoes, which were then of much greater value than they are now Each hoe was regarded as a separate payment, and ful filled a special function The presentation of the first hoe took place after arrangements for the betrothal had been made by an intermediary The man then built a hut for himself and his bride near her father for whom he was expected to work This payment did not constitute a binding contract, but the arrangement was confirmed by the payment of the second hoe It could not then be set aside on the girl's part without reason, but until she had borne a child, the husband could send her back to her father if he wished In this event, if his reason were not good, the father might not return the two hoes The husband still remained under the control of his father in law's family after the second payment, and was not emancipated from it until the payment of the third hoe had been made Even then he continued to render the family certain services and could not live more than a few miles away without their approval Although a man had much greater power over his children when the payment was complete, they continued to render greater respect to their mother's brother than to their father The custom has been much modified in recent times by economic causes, which have increased the amount payable and given the husband greater freedom from the control of the bride's family

Rock-Engravings in Tripolitania. Some of the results of a recent journey of archæological exploration in Tripolitania are described by Paolo Graziosi in *L'Anthropologie* **44** No 1–2 Until last year when two expeditions were at work, one being led by Dr L Frobenius, little was known of the rock engravings of Fezzan and nothing of the stone age industries of that area The oasis of Brach was made the head quarters of the Italian expedition, but for Wadi el Agial, Oubari served as the base In the neighbourhood of Wadi Marail, near Hamada el Homra, engravings of Bovidæ were found, of which one bore a spheroid between its horns indubitable sign of Egyptian influence One of the drawings appeared to be a rhinoceros, but was probably a badly-drawn member of the Bovidæ Two large figures of ostriches were found near El Gheriat In style these recall the oldest engravings of southern Oran Two areas which proved very rich were the Wadis Zigza and Massauda At the former the superimposition of engravings made a relative chronology possible which could be equated with variation in patina, style and technique The most ancient engravings showed giraffes in a fine naturalistic style The lines were deeply engraved and highly patinated Similar figures at Djebel el Ouenat have been demonstrated by the Abbé Breuil to be related to Bushman drawings Another group of later date shows an antelope, an aurochs and a number of Bovidæ in profile, but with the horns represented as if seen from above A third large group is composed entirely of domestic animals Here also is a human figure in a crouching attitude, which to a certain degree recalls South African art, but also has undoubted Egyptian affinities Among the latest engravings, but still anterior to the camel' period, are a number of vehicles drawn by horses and driven by men At Massauda were many rock shelters with engravings Among the most ancient, special mention is made of an elephant hunt, in which three elephants face two men armed with bows A third man lies on the ground, while others are under the animals The most numerous groups are of domestic animals and men some ithyphallic

Investigations in a Japanese Lake S Yoshimura has recently described his researches into the biology physiography, physics and chemistry of a small mountain lake near the Japan Sea (' Limnological Reconnaissance of Lake Busyû, Hukui, Japan " *Sci Rep Tokyo Bunrika Daigaku*, C, No 1, vol 1, 1932) An attempt was made by the Hukui Fisheries Station to utilise this lake for the culture of cold water fishes Lake Busyû which is elongated from north to south with its basin in the form of a pail, lies in a deep and narrow valley, the river entering from the south and flowing out at the north to enter the Japan Sea The water is very turbid greenish brown from the suspension of silt particles, and with no vegetation on the shores owing to the fluctuations in water level The surface is very hot and the bottom very cold the water weakly acidic, the surface water slightly supersaturated with dissolved oxygen, not due to the assimilation of the phytoplankton but to the sudden rise of water temperature in this layer which is exposed to the surface by the sinking of water level towards the summer The stratification of oxygen is very complex, which is an unusual feature in Japanese lakes There is no specially deep hollow but the shallow bottom is so steeply inclined that it cannot retain fine deposits What deposit there is is not decomposed mud but detritus of leaves and land plants The lake is regarded by the author as of the rich oligotrophic type The organic life consists of diatoms rotifers cladocerans and copepods in the plankton, several fishes in the nekton and in the benthos *Tubifex* at the bottom in great abundance (16–20 metres), *Endochironomus* dominant at 10–15 metres and a few *Tanypus* and *Chironomus plumosus* in the shallow bottom Fishes such as *Salvelinus* and *Coregonus* transplanted to the lake can survive

Isopods from the "Discovery" Expedition. Miss Edith M Sheppard, in her monograph on the family Serolidæ (Isopod Crustacea, Part 1, "Discovery Reports", vol 7, 1933) not only describes the collection made by the R R S *Discovery II*, the R.R.S *William Scoresby* and the staff of the Marine Biological Station of South Georgia during the years 1925–32, which is the most complete ever made both of species and specimens, but also gives a revised account of the genus *Serolis* with diagnostic characters of all known species, together with notes on their geographical distribution and general morphology Seven of the "Discovery" species are new to science, and of the fifteen shallow water species (excluding two which are doubtful) previously recorded from these waters, all except three have again been found' The genus, with the exception of one species recorded from San Diego, California, is entirely restricted to the southern hemisphere Most of the species are confined to shallow water and the deep sea forms are comparatively few in number but have a much wider vertical as well as horizontal distribution The species fall into four groups (1) outside the antarctic convergence, (2) inside the antarctic convergence, (3) round the shores of Kerguelen Island, Crozet Island, Marion Island and Prince Edward Island, (4) off the shores of South and East Australia From analysis of the adult females in the present collection the author finds that breeding goes on throughout the year, and that the number of females in the non breeding condition is comparatively small

Microsynangia of the Medulloseæ Under the title The Structure of Certain Fossil Spore Bearing Organs believed to belong to Pteridosperms , Prof Halle (*Kungl Svenska Vet Akad Handl*, Bd 12, No 6) makes a valuable contribution to our knowledge of the microsynangia of several genera attributed to the Medulloseæ A new group, Whittleseyinæ, based on the microsynangia, is proposed under which name are united several late Palæozoic spore producing organs characterised by very long tubular sporangia, an unusually strong vegetative development of the synangium and unusually large spores *Goldenbergia*, nov gen , hitherto believed to be a seed of the genus *Rhabdocarpus*, is now shown to be a large synangium formed of 12–16 tubular sporangia arranged in a single whorl enclosing a central cavity, whilst the supposed leaves or pinnules of *Whittleseya elegans* are shown to be cupule like synangia campanulate in shape and formed of very long tubular sporangia *Boulaya*, *Aulacotheca*, nov gen (*Holcospermum*), *Codonotheca* and *Dolerotheca*, nov gen (*Dolerophyllum*) are referred to this group The genus *Potoniea* is treated as the type of a second group, recalling the Whittleseyinæ but differing in structure and in the size and type of the spores In *P adiantiformis* and *P* (*Neuropteris*) *Carpentieri*, the probably free sporangia are shown to be long and tubular and to radiate from the bottom of the low, wide cup, which seems to be formed by a pinnule, the fructification being superficially likened to the capitulum of a composite *Zeilleria fructifications* are also shown to be synangia of the Whittleseyinæ type, though there is no evidence that this genus belongs to the Pteridosperms

Origin of Cultivated Tobacco The origin of cultivated tobacco, *Nicotiana Tabacum*, is a problem of considerable genetic interest In 1927, Clausen put forward the hypothesis that it was derived from a hybrid of *N sylvestris* and *N tomentosa* in which the chromosome number had been doubled This was based upon the fact that (1) *N Tabacum* has $n = 24$ chromosomes, while in the other two species $n = 12$, (2) when either of these species is crossed with *N Tabacum* the F_1 hybrids show $12_{II} + 12_{I}$ chromosomes in meiosis, indicating that each had a haploid set homologous with 12 of the *Tabacum* chromosomes Dr. D Kostoff (*Bull Appl Bot*, Ser 2, No 5, 1933) has recently reported upon extensive crosses involving these three species and also *N Rusbyi*, a woody-stemmed species nearest *N tomentosa* He points out difficulties with the above hypothesis, based partly on the absence of woody varieties of *Tabacum*, partly on the fact that many varieties of tobacco have pink flowers, while those of *N sylvestris* are white and those of *tomentosa* and *Rusbyi* rose green, and partly on the chromosome behaviour in the various hybrids Brieger has also argued against Clausen's hypothesis on the basis of similar experiments Kostoff produced the triple fertile species hybrid *N Tabacum* × (*N sylvestris* × *N Rusbyi*) which he calls *N triplex*, this appears to have originated from an egg cell of tobacco (with 24 chromosomes) meeting a male nucleus having 12 *sylvestris* and 12 *Rusbyi* chromosomes The hybrid thus has a complete haploid set of all three species and combines all their characters It is, moreover, cytologically balanced and produces normal gametes Nevertheless, it shows variations, and from numerous cytogenetic studies of its hybrids the conclusion is reached that while tobacco did not arise from the present *sylvestris* and *tomentosa*, yet it probably was derived from related forms which perhaps no longer exist

Winter Pruning of Apple Trees The practice of pruning was devised long before the opening of the Christian era yet it is only in recent times that an attempt has been made to understand the fundamentals of the process Hatton, Grubb and Amos, working at the East Malling Research Station, began experiments, and issued an early report in 1923 Their work has been continued by Dr R C Knight, who has recently published a further paper ("The Influence of Winter Stem Pruning on Subsequent Stem and Root Development in the Apple", *J Pom and Hort Sci*, 12, No 1, 1–14, March 1934) The earlier results are confirmed by improved experiments on more than five hundred trees of several varieties and grafted upon different rootstocks Winter pruning decreases the production of new roots, but increases shoot formation, though often at the expense of radial thickening There is, indeed, a decrease in the total amount of shoot growth, considered as extension growth plus increase in girth, and the relation of new shoot growth to new root growth is remarkably constant No influence of stem pruning on the type of root system was found The practical point, that it is better to prune immediately after planting if extension growth is required, emerges from a consideration of the results

Condensation of Water in the Atmosphere M G Bennett has reviewed (*Quart J Roy Met Soc*, Jan 1934) the present state of our knowledge in regard to the condensation of water in the atmosphere, the theory of which is found to be very much more complex than was formerly supposed Measurements of the sizes of droplets in fog and cloud made independently by several observers within the last thirty years, and especially within the last three or four years, are commonly held to suggest that the masses of the droplets are integral multiples of one of two standard minimum sizes, which appears to imply that the production of the larger drops takes place by the union of the smaller drops and not by their continuous gradual growth by condensation It was found further that the concentrations of chlorides in the droplets were integral multiples of the smallest concentrations ever observed It might be supposed that some very simple account of the process of drop formation could be based on these observations, but according to Bennett, any such account is incomplete Another difficult problem is the question whether a cloud or fog which is not subjected to changes of relative humidity is stable or whether it will tend to coagulate into larger drops. The electric charges carried by the droplets affect their vapour pressure slightly according to a relationship worked out by J. J. Thomson, the radius of curvature of the drops and the surface tension of the liquid being among the additional controlling factors, but the effect on the vapour pressure of the charges that have been measured is extremely small in the case of droplets as small as those in a fog; such charges may, however, affect the rate of coagulation of the droplets into drops. It is evident that the parts played both by the electrical charges and by the relative humidity in the growth and coagulation of drops in cloud and fog remain to be discovered.

Scattering of Hard X-Rays. A number of formulæ have from time to time been used for the intensity of the Compton scattering of hard X-rays, in particular one derived by Klein and Nishina on relativistic quantum mechanics. J. Read and C. C. Lauritsen (*Phys. Rev.*, April 1) have tested this formula experimentally using a high potential X-ray tube and a crystal spectrometer. The absorption per electron was measured in carbon and aluminium over a wave-length range of 20–50 X units (250–600 kv.). Over this range, the photoelectric absorption by the electrons is small and nuclear absorption is not to be expected, while the Klein–Nishina result differs appreciably from those given by the older theories. The experiment shows that the Klein–Nishina formula probably gives the correct scattering coefficient within one per cent over this wave-length range.

Fine Structure of X-Ray Absorption Edges. It is well known that when X-rays are absorbed by a solid, the short wave side of the absorption edge shows in general a pattern of maxima and minima. According to a theory of Kronig the electron extracted from the atom may only move through the periodic field of the lattice with certain discrete energies, the forbidden energies corresponding to Bragg reflections of the electron waves. This effect must be integrated to allow for the motion of electrons in all directions through the lattice. The theory is confirmed by investigations of the absorption edges of nickel, iron and chromium in the pure metals and in alloys of gradually varying lattice constant. D. Coster and G. Klamer (*Physica*, January) have investigated the fine structure of the potassium and chlorine *K* edges in potassium chloride crystals, using a vacuum spectrograph. The fine structures observed with these two elements were totally dissimilar, and if Kronig's view of the effect is to be applied to ionic crystal lattices, it seems that the rules which govern the transitions of the *K* electrons to the crystal lattice are quite different in the case of the Cl^- ion and the K^+ ion.

Optical Isomerism of the Menthols and Menthylamines. Prof. J. Read and Mr. W. J. Grubb have now described (*J. Chem. Soc.*, March) the isolation and characterisation of "the last of the menthols", namely, *d-neo-iso*-menthol, thus bringing to a successful conclusion a brilliant series of researches carried out by Prof. Read and his colleagues upon the highly complex group of menthylamines and menthols, all the stereoisomerides of which have now been isolated and characterised. Some idea of the formidable nature of the problem involved will be formed when one realises that the *cis-trans* isomerism of the parent menthone molecule is complicated not only by the asymmetry of two dissimilar carbon atoms at the points of attachment of the methyl and isopropyl groups but also by the development of a third 'centre of asymmetry' at the position of the original keto group. Thus menthylamine and menthol each give rise to eight optically active isomers, of which only four are needed for complete characterisation. In addition, there are the corresponding inactive *dl* forms to be considered. Comparison of the optical rotatory powers of the various compounds of the whole group reveals a complete parallelism between the amines and the alcohols, thus showing that the four sets of compounds are stereochemically analogous, although the relative molecular configurations are not yet to be regarded as finally settled. This work forms a valuable contribution to the study of stereochemical problems.

Propane-treated Automobile Oil. Science Service, Washington, D.C., has recently issued a Mail Report describing a new method of production of lubricating oil. Propane, as a liquified natural gas, is mixed with asphaltic base petroleum. The two liquids separate out into two layers, but not until the propane has extracted the desirable components from the asphaltic layer. The propane layer is then recovered with nitrobenzene, which cleans it from traces of remaining asphalt, and the lubricant is finally obtained by evaporation of the propane solution. Oil equal, if not superior, to Pennsylvania oil as at present refined can be produced in this way from cheap western oil. Proof of its efficiency is furnished by the results of stringent practical tests. Cylinder tops, lubricated with propane-treated oil, after 60,000 miles of high-speed duty, were less than one thousandth of an inch out of the perfect circle. Normally, under similar strain the tops would have been deformed into an oval shape. Comparatively easy production and efficient performance of such oil under test have done much to discount alarm caused by threatened exhaustion of good Pennsylvanian oil, since Texas, Oklahoma and California are now in a position equally with Pennsylvania to meet the demand for this product.

Colour Temperatures of Stars. In the *Observatory* of May appears an account of a paper by Messrs. Greaves, Davidson and Martin, to appear shortly in the *Monthly Notices of the Royal Astronomical Society*, describing a revision of the fundamental scale of colour temperatures which the authors have worked out at Greenwich. They have improved their photometric technique, but the change in the temperature scale is primarily due to a general revision of laboratory standards of colour. The temperatures which these authors actually find are very noteworthy, as they are markedly higher than previous estimates of colour temperature and ionisation temperature. For example, the Greenwich temperature for the mean *A0* star is now 18,000°—to be compared with 11,000° quoted by Russell, Dugan and Stewart ("Astronomy", Ginn and Co., New York, 1927). The Greenwich work comes on top of some recent observations which indicate that the colour temperature of the sun is about 6,800°, that is to say, definitely higher than the effective temperature, 5,740°. The Greenwich workers find 6,800° for the mean colour temperature of a number of *G0* stars.

Chemical Syntheses under Pressure

BY invitation of the president Prof G T Morgan, an ordinary scientific meeting of the Chemical Society was held at the Chemical Research Laboratory on Thursday, June 7, when three papers were contributed illustrating recent researches in the Laboratory on syntheses of organic substances under pressure

Mr R Taylor described the circulatory plant (afterwards seen in operation) employed in studying condensations between carbon monoxide and hydrogen at 400° and under 250 atmospheres in the presence of various catalysts with a rate of circulation of about 80 litres of compressed gas per hour In these researches, attention has been directed specially to the production of alcohols other than methyl alcohol (methanol) With a catalyst consisting of cobalt sulphide mixed with oxides of copper and manganese, an optimum yield of ethyl alcohol was obtained although this synthesis was always accompanied by large amounts of methane Systematic fractionation showed that more than ninety per cent of a product (b p 783°) consisted of alcohols with unbranched chains among which *n* hexyl and *n* heptyl alcohols were identified Branched chain products were represented by *iso*butyl alcohol 2 methylbutanol and 2 methylpentanol A manganese chromium catalyst strongly alkalised by rubidia gave a product in which all alcohols identified above the C_3 compound had branched chains Another catalyst containing cobalt and strong alkali gave a mixture of branched and straight chain alcohols

The chemical reactions involved in these syntheses were discussed and successive aldolisation and hydrogenation were suggested as the directive mechanism For straight chain alcohols acetaldehyde (a product actually identified in these condensations) must be present to provide the active hydrogen for aldolisation, and its condensation with propaldehyde would eventually lead to *n* amyl alcohol When propaldehyde furnishes the active hydrogen the final product is 2 methylpentanol It may become possible to build up alcohols with a predetermined number of carbon atoms

Dr D V N Hardy indicated an alternative mechanism by which it is supposed that carbon monoxide is added directly to alcohols with production of acids, which may then be reduced to aldehydes and alcohols The condensations between methyl alcohol and carbon monoxide have been studied at 320° 340° under a pressure of 150 atmospheres in the presence of phosphoric acid The gas was circulated at a rate of 2 cubic metres per hour, and 120 gm of methyl alcohol vapour was introduced into the system during the same period Acetic acid and methyl acetate were obtained, together with an oily layer containing high boiling hydrocarbons from which hexamethyl benzene was isolated When 2 per cent by weight of copper phosphate was added to the phosphoric acid, this oily layer was no longer formed and larger proportions of acetic acid and its methyl ester were obtained Some dimethyl ether was identified but as it did not accumulate in the system it may be regarded as a reagent These experiments favour the view that a methylene radical is produced which unites with carbon monoxide to form ketene, this reactive compound being then hydrated and methylated to acetic acid and methyl acetate respectively

Dr D D Pratt discussed the use made of autoclaves in practically all research sections of the Laboratory These autoclaves which have been constructed in the laboratory workshop have capacities ranging from 50 c c to 10 litres, they are capable of withstanding pressures of 200 atmospheres at temperatures up to 450

Phenols aromatic hydrocarbons and bases undergo carboxylation when condensed with carbon dioxide under pressure in presence of catalysts such as aluminium and zinc chlorides

High pressure aminations of alcohols and phenols have led to significant results Resorcinol and orcinol heated to 200° with aqueous ammonia give rise to *m* aminophenol and 5 amino *m* cresol respectively In similar circumstances resorcinol and ethylamine furnish *m* ethylaminophenol an important colour intermediate

Autoclave experiments have been made on the reactions between hydroxylic compounds and ammonium chloride At 300° ethyl alcohol gives a mixture of mono di and tri ethylamines separated by fractionation through a Dufton column At 320°–350° phenols are converted into a mixture of primary and secondary amines This amination which is particularly successful with *m* cresol and symmetrical xylenol is of technical importance, since the resulting *m* toluidine and 1 3 5 xylidine are not readily obtained by successive nitration and reduction from toluene and *m* xylene In these aminations of phenolic homologues the effect of orientation in the aromatic nucleus is plainly discernible In the diphenyl series the ammonium chloride reaction on 2 hydroxydiphenyl and 2 2′ dihydroxydiphenyl leads respectively to *o* xenylamine and carbazole, another important colour intermediate

At the conclusion of the meeting the visitors were conducted through the laboratories in which exhibits and demonstrations had been arranged illustrating the following researches —

Synthetic production of methyl and other alcohols from carbon monoxide and hydrogen and the synthesis of acetic acid from methyl alcohol and carbon monoxide For the characterisation of higher aldehydes and alcohols it is necessary to have authentic specimens of well-crystallised derivatives, and a collection of these products was on view

In the tar section there were demonstrations of shirlacrol a new wetting agent used in mercerising cotton and of the extraction of catechol and resorcinol from industrial liquors The identification of tar constituents involves the synthesis of higher phenols and complex aromatic hydrocarbons Distinctive specimens of such products were exhibited together with fuel oils derived from the hydrogenation of tars In the road tar section a large scale plant for the separation of the crystalloid and resinoid constituents of tars was in actual operation

The allied sections of chemotherapy and synthetic resins were illustrated by comprehensive collections

Inorganic chemistry was represented by researches on the aerial and immersed corrosion of metals, the production of base exchange materials from English clays and the isolation of rarer metals such as germanium and rhenium from British minerals The exhibits arranged by the microbiological and dental investigation sections were also greatly appreciated by the visitors, who numbered about 260

New Regulations for the Natural Sciences Tripos

THE Committee of the Natural Sciences Tripos at Cambridge has issued a report on the regulations for that Tripos The changes suggested in Part I are consequential on the recommendations of the Syndicate on Medical Courses and Examinations New half subjects are introduced in biochemistry, physical and inorganic chemistry, organic chemistry, pathology and zoology (mathematics is already a half subject) Every candidate must take at least three whole subjects or at least two whole subjects and two half subjects

Anatomy (a whole subject) is to consist of approximately equal proportions of topographical anatomy and scientific anatomy (embryology and morphology) A broad, rather than a detailed, knowledge of topographical anatomy will be required The questions will deal mainly with the general architecture of the body and will not require a detailed knowledge, except of the more important areas In the papers on physiology there are to be some optional questions on pharmacology, but it will be possible to obtain full marks in physiology without attempting any questions in pharmacology

The half subject pathology is to be treated from the point of view of abnormal biology and is to include the variations which may occur in the structure and functions of living tissues and organs, together with the biology of parasites bacteria and viruses In the half subject biochemistry, a knowledge of the chemical processes associated with the normal life and growth of animal and vegetable organisms including micro organisms is required

In Part II, one of the four papers in geology and in mineralogy and petrology is to be common to both subjects Candidates in geology may substitute one of the papers in mineralogy for one of the papers in geology and vice versa Candidates in physiology may substitute for a specified paper in physiology a paper in pharmacology or for two specified papers in physiology two papers in experimental psychology

In Part II (chemistry), the first two papers will be of such a nature as to test the candidates' knowledge of general chemical science The third and fourth papers will be set so as to enable candidates to show a specialised knowledge of some of the subdivisions of chemistry They will include questions in inorganic, organic, theoretical and physical chemistry colloid science metallurgy, crystal chemistry; and candidates will be allowed complete freedom of choice in the questions which they attempt A sufficient number of questions will be set in each of the subdivisions for a candidate to attain the standard of the first class by answering questions in one or more of them

In Part II (physics) the first three papers will be of such a nature as to test the candidates general knowledge of physics The fourth paper will be of such a nature as to enable candidates to show a specialised knowledge of some branches of physics This will contain a large choice of questions so that it will not be necessary for a candidate to have a specialised knowledge of all branches of the subject This paper will include a sufficient number of questions on crystallography and crystal physics for a candidate to be able to gain full marks on the paper by answering questions on those branches only

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Russian Studies of the Stratosphere*

PLANS for the ascent into the stratosphere in the U S S R were first made in December 1932, and after various preparations the actual ascent was made on September 30, 1933, by G A Prokofiev, K D Godunov and Birnbaum A height of nearly 19,000 metres was reached The Central Geophysical Observatory has now issued a report in Russian of the ascent

The original intention was to take measurements of the pressure and temperature of air intensity and hardness of cosmic rays, intensity of electric field conductivity of atmosphere, intensity of solar radiations, and analyses of the air, at various heights It was, however, decided that in order not to overburden the balloon with the weight of all the necessary apparatus, the measurements of the intensity of electric field and solar radiation, as well as the observations on the conductivity of air, were to be postponed to the subsequent ascents

The intensity of cosmic rays was measured by means of a Kolhörster electrometer, made of iron volume 4,200 cm ^{3} and electrostatic capacity 0 35 cm During the ascent, the electrometer was charged by means of an ebonite rod Measurements were made between the heights of 9,600 metres and 15,900 metres, the maximum possible error was estimated as 5 per cent The results obtained show fair agreement with Prof Piccard s observations but there is a discrepancy of more than 30 per cent with the results of Prof Regener

Prof Regener s observations		Prof Piccard s observations		Russian observations	
Pressure in mm Hg	Intensity of cosmic rays	Pressure in mm Hg	Intensity of cosmic rays	Pressure in mm Hg	Intensity of cosmic rays
	ions/cm ^{3}/sec		ions cm.^{3}/sec		ions/cm ^{3}/sec
150	153	142	215	137	221
100	224	127	248	86	345 3
75	243	88 5	305		
		83	313		

In order to measure the hardness of cosmic rays, a specially adapted Hesse electrometer was used, volume 1,100 cm ^{3}, electrostatic capacity 1 2 cm The electrometer was charged again by an ebonite rod, and was placed in a lead filter, with a wall thickness of 30 mm The first set of measurements was taken at the height of 17,500–17,900 metres, when the electrometer was covered by the lead filter on all sides The ionisation found was 338 ions per c c per sec, with a possible maximum error estimated at 8 per cent A second set of measurements was taken at the height of 17,400–17,900 metres, but with the lead lid of the filter taken off The ionisation found in this case was 415 ions per c c per sec , within a possible error of 5 per cent

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* The Central Geophysical Observatory and the Ascent into the Stratosphere on September 30 1933 A collection of articles (in Russian) by various authors Pp 26 Leningrad 1934 1 rub

This series of results differs considerably from the results obtained by means of the Kolhörster electrometer (height 15,460 metres), and with the results obtained by Prof Piccard Unfortunately, no measurements were made with the Hesse electrometer completely out of the lead filter The excess of ionisation is considered by the author (A B Verigo) to be due to the secondary radiations arising in the zinc walls of the electrometer under the action of cosmic rays

Samples of air in the stratosphere were taken by means of specially constructed glass balloons suspended outside Precautions were made to prevent possible contamination by air or gases which might arise from the balloon itself The sample taking balloons were originally at high vacuum and were opened and sealed electrically Full descriptions of these small balloons are given

In order to prevent contamination, samples of air were only taken during descent or when the balloon was floating Analyses of the air samples were made independently by A V Moskvin in the Electrophysical Institute and by A A Tcherepennikov in the Gas Analysis Laboratory of the Central Geological Institute The following results were obtained

(1) Pressure inside the balloon after reducing to the original volume (1,120 c c) and to a temperature of − 55° C was 47 5 ± 2 mm mercury

(2) No hydrogen was found

(3) The percentage volume of oxygen was 20 95 at a height of 18,500 metres

(4) The contents of nitrogen and the sum of inert gases scarcely differ from the contents of air at the earth's surface

The results obtained were so unexpected that a suggestion had to be considered that, owing to some unforeseen circumstances the sample taking balloons were filled by air somewhere near the surface of earth This suggestion was disproved by measuring the humidity of air in the sampling balloons A mirror hygrometer was used At the temperature of liquid air no traces of moisture were found Parallel experiments on specially dried air from the earth s surface with water vapour contents estimated at 0 5, 0 1 and 0 02 mm mercury gave positive results on the same mirror This ruled out the possibility that the air in the glass sampling balloons was taken on the earth s surface, and the author (M I Golzman) suggests that there can be no doubt that the air in the sample balloons was taken in the stratosphere

The lowest temperature observed during the ascent was − 57° C Measurements were made by a platinum thermometer and Wheatstone bridge

The rest of the pamphlet gives descriptions of the various pieces of apparatus that were used during the ascent the way in which they were arranged inside the balloon and also of other equipment which was prepared but not used in order to avoid overburdening the balloon

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Archæology of the Caucasus

THE late Prof Reginald W Fessenden author of The Deluged Civilization of the Caucasus (see NATURE, 113 317 March 1 1924) who had devoted forty years to the study of the prehistory of the Caucasus and had collected hundreds of thousands of references to the area, left much material still unpublished at the time of his death Additional chapters of his book and a number of collected papers have now been privately printed—unfortunately for purposes of reference, under the same title In these the author had put forward further applications of his theories which were based upon an intensive study of the mythology of ancient Egypt, Mesopotamia and Greece, of names, both personal and place names, and of ancient geography He again aimed at showing that there is evidence to support his view that not only was the Caucasus the land of the Book of the Dead, the original home of the Egyptians, the scene of ancient stories such as that of the labours of Hercules and the place of origin of Abraham , but also that it is the centre from which sprang all the great civilisations of antiquity, as well as the place of differentiation of the white and black races from a negrito stock

Prof Fessenden here also attacked the question of Atlantis and the Platonic numerical cipher of the 'Critias", as well as the Egyptian origin of masonry The author was neither an archæologist nor a philologist ; and in working out the identification of names of places and the interpretation of references in the traditions, he used material of very unequal value indiscriminately Yet his suggestions at times were remarkably acute His theories attached a significance to the Caucasian area which archæological research may well confirm, at least, in part

There has been a number of indications recently pointing to the importance of the Caucasus as an area for exploration in relation to the early prehistory of adjacent countries , while the richness of the country on the eastern side of the Caspian in evidences of antiquity has to be seen to be believed This must not be taken to endorse Prof Fessenden s belief that exploration with oil boring apparatus would bring to light the contemporary records of the pre diluvial period which he held according to tradition, had been buried in subterranean chambers Reference at the moment is opportune, as the time is ripe for action The Soviet Governments are willing, and indeed anxious to co operate with outside bodies in the work of anthropological research They have already approached the United States, and one joint expedition has been at work on an ancient Gothic site in the Crimea on behalf of the Academy of the History of Ancient Culture and the University of Pennsylvania Museum This expedition has enriched the latter institution to the extent of 3,600 objects, ranging in date from the historic period to 1500 B C The matter is not without urgency, as in certain areas the exploitation by the Government of material resources is a source of danger to the antiquities

In the northern Caucasus the construction of an immense hydro electric station will inundate a large area in which, it is estimated, in a year's time, some hundreds of burial mounds and tombs of the early bronze age and other archæological monuments of later date, belonging to the Scythic, Gothic or Tartar civilisations, will have been irreparably damaged or entirely destroyed. In order that something at least may be saved, the Soviet Academy for the History of Early Culture has again asked for the co-operation of the University of Pennsylvania Museum. As the level of the water has already been raised 19 ft. in the past year, it will be possible to save only a limited amount by excavation before next autumn, when the work is to be completed. Yet the value of the material which is thus being lost to archæological science is incalculable. Not merely has the north Caucasus been examined only very imperfectly but also the implications of the discoveries already made in this area are very little appreciated. On this point it is worth while to glance at a communication by Prof. V. L. Avdief of Moscow on the relations of the Caucasus and early Egypt, which appears in *Ancient Egypt and the East*, Pts. 1-2, 1933. Prof. Avdief points out that the most valuable evidence on the cultural relations of the Caucasus and the countries of the ancient East is to be expected from the monuments of the chalcolithic and bronze age cultures of the Koban type in the Euxine region. In the Ossetian and Kabarda Balkaria Autonomous Region of the North Caucasus, where the author conducted excavations in 1931-32, the bronze and chalcolithic cultures are well developed. Here there were extensive deposits of copper ore, which indeed are not yet exhausted. In prehistoric times the tribes constantly extracted and worked these ores. The numerous bronze objects recently discovered in that area present close resemblances to those found at Koban. For example, a small stone hatchet, possibly ceremonial, found near Nalchik, fairly polished, with a central bored hole and partly bent downward, resembles one found at Koban. The pottery with incised line decoration painted white, the representation of animals in bronze akin to the Koban 'animal style' and finally the mode of burial in stone cists exemplify the same relation.

Certain objects found at Balkaria show relationship with ancient Egyptian culture. One of the most striking is an anthropomorphic deity standing in the middle of a circle which may symbolise the sun. It is comparable to a representation of the god Bes or Pateka. Late Egyptian (Hellenistic or Roman) objects found in Balkaria prove cultural or commercial relations in the first millennium B.C., and these relations are shown by a number of objects of domestic purpose to have extended to Assyria and Babylonia, although the actual trade routes are difficult to establish.

Energy Relationships in Chemical Reactions

IN opening a discussion at the Royal Society on May 10 on the "Energy Distribution in Molecules in Relation to Chemical Reactions", Mr. C. N. Hinshelwood referred to some unimolecular reactions in which the velocity curve seems to be composed of several curves superposed, and suggested an interpretation in which several virtually independent reactions are taking place at the same time, all unimolecular and differing only in the values of the various characteristic constants. It is supposed that once a molecule has received its activation energy the internal rearrangement of this is relatively difficult, and according to the original way in which the energy was placed in the molecule there will be a different probability of chemical decomposition.

Investigations show that with certain substances molecules with activation energy differently located or distributed seem to behave as virtually independent entities for kinetic purposes; that there is a limited number of types of such molecules, and that the chance that activation energy is communicated to a molecule in such a way as to cause rapid decomposition is relatively much greater in substituted molecules such as C_6H_5CHO as compared with HCHO. Investigations in liquid systems seem to suggest that there are two extreme cases, in one of which the rate of reaction is primarily determined by the acquisition of the necessary activation energy, and in the second a probability factor independent of temperature is of equal or greater importance and the reaction velocity is many powers of ten smaller than the activation rate.

There is a suggestive connexion between this and the remarkable catalytic effect of solvents, often roughly parallel with their polarity, on one hand, and on the other hand with the fact that in reactions where one of the reactants is an ion, the rate is usually nearly equal to the activation rate, as though the great electrostatic forces contributed a perturbation powerful enough to increase the transformation probability to nearly unity.

Barking Power Station

THE new generating station of the County of London Electric Supply Co., Ltd., is situated at Barking on the bank of the River Thames about half a mile below Barking Creek. Its output is now 390,000 kilowatts, the largest in Britain, and when completed it will be about 600,000 kilowatts and will probably be the largest in Europe. It plays the leading part for the south-east England area in the Central Electricity Board's scheme. Ten circuits converge on Barking, six at 132 kilovolts and four at 66 kv. The Board's transforming station is situated on the opposite side of the road to the power station and is equipped with several very large high tension transformers.

The Company with its associated companies supply power over an area of about 3,000 square miles. It supplies four London boroughs and a large number of the inner suburbs. In addition, it supplies various districts in Surrey and Essex. The associated companies feed large parts of Kent and Sussex. It is also developing outer areas under various electrification schemes. According to *Distribution of Electricity* of February, published by Messrs. W. T. Henley's Telegraph Works, it is intended ultimately to provide a supply for each village or township in the area having a population of 500 or more persons. In addition, transmission lines along the route will in due course be tapped at any point where a demand exists There are now more than seventy towns and villages where electric supply is available There are several large poultry farms where electric hatcheries are in operation Farms also use the electric supply for fruit and vegetable canning and there are flour mills small water and sewerage schemes, gravel and sand pits brick making and timber yards and sawing mills where it is employed In addition to supplying electricity in bulk to many supply undertakings it also supplies for traction purposes the London Midland and Scottish Railway and the London Passenger Transport Board (Morden Tube)

The new extensions of the Barking power station work with a boiler pressure of 600 lb per sq inch The temperature of the steam is therefore about 800° F A few years ago it looked as if a still higher pressure would become the standard In America steam pressures of 1 200 lb per sq inch were first used, later pressures above 3 000 lb per sq inch were used in Europe Seeing that the new Battersea power station works at between 600 lb and 650 lb pressure and that the new Fulham station is being designed for this pressure it looks as if 650 lb would become the standard pressure It is interesting to remember that early steam boilers worked with pressures of about 8 lb

University and Educational Intelligence

CAMBRIDGE—The following appointments have been made—J H Driberg University lecturer in anthropology, Dr S Dickinson University lecturer in mycology in the Department of Agriculture W J Dowson (Christ s College) University lecturer in mycology in the Department of Botany and Dr H Godwin (Clare College) University lecturer in botany

The degree of M A *honoris causa* has been conferred on Sir Charles Martin formerly director of the Lister Institute of Preventive Medicine and professor of experimental pathology in the University of London

At Girton College Dr O Taussky and Dr C Leubuscher have been elected to research fellowships

On June 6 the following honorary degrees among others were conferred Sc D Prof Alfred Fowler Yarrow research professor of the Royal Society and professor of astrophysics in the Imperial College of Science Litt D Prof Samuel Alexander honorary professor of philosophy in the University of Manchester

LIVERPOOL—The Council of the University has accepted with regret the resignation of Mr R O Street senior lecturer in applied mathematics on his appointment to the chair of mathematics in the Royal Technical College Glasgow

The University of Berne has conferred the honorary degree of D Sc on Prof Share Jones director of veterinary studies and professor of veterinary anatomy in the University in recognition of his services to veterinary education and his distinction in his own branch of research

SHEFFIELD—The title of emeritus professor has been conferred on Prof Edward Mellanby formerly professor of pharmacology in the University

Science News a Century Ago

The Royal Society

At the meeting held on June 19, 1834 fourteen papers were taken, amongst those a paper submitted on borings and ravages in timber by William Thompson vice president of the Natural History Society of Belfast was widely reported at the time The opinion advanced that the *Teredo navalis* had ceased to be found on the British coast was shown by the author to be erroneous since numerous specimens had been collected from the piles used in the formation of the pier at Portpatrick in Ayrshire

The subjoined letter from Mr J G Children Sec R S addressed to Mr Francis Baily, vice president was read: British Museum June 19 1934 His Royal Highness the President requests that when you adjourn the meeting this evening to the 20th of November you will have the goodness to express his great regret that unfortunately the state of his health and sight has lately been such as to render it impossible for him to preside at the ordinary meetings of the Society so regularly as it was his anxious wish to have done His Royal Highness begs you will assure the Society that his absence has been occasioned by the cause alluded to alone and from no feeling of diminished interest in the prosperity of the Royal Society or of regard and respect for the Fellows on the contrary His Royal Highness hopes that by the blessing of Providence his health will soon be in all respects so far re established as to enable him on the reassembling of the Society to resume the chair and fill it with that uninterrupted regularity which it is His Royal Highness s most anxious wish to observe in whatever duty he undertakes PS His Royal Highness requests you will in his name bid the Fellows heartily farewell till he meets them again in November (*Proc R y Soc* vol 3)

Cause of the Aurora Borealis

A paper On the Nature and Origin of the Aurora Borealis by the Rev George Fisher read before the Royal Society on June 19 forms an excellent illustration of the state of geophysics in 1834 Arguing from the general fact that the Aurora Borealis is developed chiefly on the edge of the Frozen Sea or wherever there is a vast accumulation of ice the author concludes that it is an electrical phenomenon arising from the positive electricity of the atmosphere developed by the rapid condensation of the atmosphere in the act of freezing and the induced negative electricity of the surrounding portions of the atmosphere and that it is the immediate consequence of the restoration of the equilibrium by the intervention of the frozen particles which being imperfect conductors become luminous while transmitting this electricity In tropical and temperate climates this phenomenon does not occur because the electric equilibrium is restored by means of aqueous vapours, a process which often gives rise to thunder and lightning

Lardner on Babbage's Calculating Machine

A century ago few men of science were more widely known than Dr Dionysius Lardner (1793-1859) who from 1827 until 1840 held the chair of natural philosophy and astronomy in University College, London The writer of many textbooks he projected the Cabinet Cyclopaedia and secured for it the co operation of Herschel, Brewster, Powell and other distinguished men He was also well known as a lecturer, and on June 21, 1834, he lectured to a crowded audience in the theatre of the Mechanics' Institution on Babbage's calculating machine, to the cost of which the Government had contributed largely, but the construction of which was then at a standstill Lardner dealt with the history and the principles of calculating machines and referred to their importance for the construction of correct mathematical tables In its report of the lecture, the *Times* said that it would be considered a matter of national concern if means were withheld for the completion of Babbage's machine The occasion was rendered notable by the presence in the chair of Lord Brougham and the attendance of M A Dupin, the president of the French Chamber of Deputies, whom the Committee of Management elected an honorary member of the Institution M Dupin was the brother of Baron Charles Dupin (1784 1873), the mathematician who had written on the manufactures and industries of England In announcing M Dupin's election, Dr Birkbeck said he trusted, after what M Dupin had heard that evening, that he would be induced to continue to lend his powerful aid and assistance to his brother in promoting the establishment of similar institutions to their own in France

McCormick patents his Reaping Machine

There were many pioneers of the reaping machine but the outstanding inventor was Cyrus Hall McCormick (1809–84) His machine was exhibited at the Great Exhibition of 1837 and the *Times* said of it that 'if it fulfilled its promise, [it] was worth the whole cost of the Exhibition" McCormick was the son of Robert McCormick (1780–1846) of Walnut Grove" Farm, Virginia, a man of many interests who himself attempted but abandoned the task of constructing a reaping machine At the age of twenty two years, young McCormick, undaunted by his father's failures, took up the problem and in a year or two produced a machine which was tried with considerable success ' The fundamental principles in this reaper," a recent writer has said, the divider, reel, straight reciprocating knife, fingers or guard, main wheel and gearing, and front-side draft traction, together with their peculiar combination, have proved essential to reaping machinery down to the present time " McCormick, faced with a rival in Obed Hussey, patented his important invention on June 21, 1834 He spent several years in perfecting it, but finding difficulty in getting his machines constructed, in 1847 founded a works at Chicago, then a small lake side port By 1851 he was building 1 000 machines a year and in 1857 constructed 23,000 The firm he founded is now the International Harvester Company McCormick became very wealthy and many honours came to him, the Paris Academy of Sciences in 1879 electing him a foreign member "as having done more for agriculture than any other living man"

Magnetic Survey of the British Isles

In 1834 Capt (afterwards Sir Edward) Sabine commenced, in conjunction with the Rev. Humphrey Lloyd and Capt (afterwards Sir James) Ross, the first systematic magnetic survey ever made of the British Islands The results were published in a series of reports to the British Association, commencing 1835, and the first observations (apart from some preliminary tests of instruments) appear to have been made by Sabine at Limerick on June 21 1834 The British Association report for 1835 contains a "Magnetic Chart of Ireland A D 1835" In 1836 Sabine, almost single handed, extended the survey to Scotland and in 1837, with Lloyd, Ross and other collaborators, to England The recording plotting and combining of the observations to obtain the most probable mean results represent a very large undertaking

The Overland Route to India

At a meeting of the Royal Geographical Society held on June 23, 1834, presided over by John Barrow a paper was read "On the Manners of the Inhabitants of the Southern Coast of Arabia and Shores of the Red Sea, with Remarks on the Ancient and Modern Geography of that Quarter, and the Road through the Desert from Kosir to Kenah" This paper was communicated by James Bird, who had lately returned by that route from India Bird had made the passage from Bombay to Aden, and thence to Jeddah and Kosir by a steam packet, and the interest in his account was heightened by the project of steam navigation to India having just been made the subject for a public inquiry

Societies and Academies

London

Royal Society, June 7 G I TAYLOR (1) The mechanism of plastic deformation of crystals Plastic strain is chiefly due to the sliding of one plane of atoms over its immediate neighbour in such a way that the perfect crystal structure is re formed after each atomic jump Slipping occurs over limited lengths of the slip plane, and this type of plastic strain necessarily gives rise to elastic stresses near the two dislocations which occur at the two ends of each of these lengths The assumption that such dislocations will migrate through the crystal, owing perhaps to temperature agitation, under the influence of even the smallest shear stress, leads to a definite picture of the mechanics of plastic distortion (2) The strength of rock salt Experiment shows that plastic strain in rock salt is the main factor determining the strength of well annealed crystals A recent theory of the strength of metals is applied to rock salt and shown to lead to a parabolic relationship between tensile stress and plastic strain It is concluded that the strain in rock salt occurs in the crystalline parts of the structure where the crystal order is perfect, and that the strength is determined by the mean free path of the centres of dislocation The latter, which is of the order of 10^{-4} cm , is determined by the distance apart of the faults and by the temperature *The theory therefore assigns a definite function to the faults in determining the strength of crystals irrespective of their actual crystallographic or atomic nature* C A. BEEVERS and H LIPSON. The crystal structure of copper sulphate pentahydrate, $CuSO_4.5H_2O$ The copper atoms lie on the special positions (000) and $(\frac{1}{2}\frac{1}{2}0)$ and the sulphur upon the general position (0 01 0 29 0 64) *Four of the waters* are arranged in squares around the coppers, and two oxygens make with these approximate octahedra The fifth water is not co-ordinated, but is in contact with two oxygens and two waters All the waters show two oxygen bonds each, in accordance with recent ideas

Paris

Academy of Sciences, April 23 (*C.R* 198 1465–1556) Louis Roy Remarks on the construction of a standard of self inductance J Haag The hypothesis of fibres The elementary theory of elasticity supposes the elastic body to be composed of small independent parallel cylinders to each of which the formula of extension is applied In general this is inexact The present paper discusses all the cases for which this hypothesis is rigorously correct S Ikeno Heredity of gynodiœcia in *Petasites japonicus* Sylvain Wachs Linear systems of unilateral quaternion equations W Margoulis The minimum of power consumed by flying machines Jules Géhéniau The tensor of polarisation Adrien Jaquerod Classification of atomic masses Jean Savard Compensation of the electronic energy and the energy of repulsion in the hydrogen molecule Th V Ionescu and Mlle Ionica Cerkez A new method for amplifying and producing low frequency oscillations The apparatus described gives oscillating currents of 0 5–1 amp with frequencies between 2 and 15 000 cycles a second Ion I Agarbiceanu The mean life of a spectroscopic term and width of the lines of the spectrum Guillien The existence of the dimer O_4 in liquid oxygen From evidence based on the ultra violet absorption spectrum the author concludes that liquid oxygen is a mixture of molecules of O_2 and O_4 René Audubert and Jean Roulleau The mechanism of the action of light on selenium electrolytic photocells F Bourion and E Rouyer Determination of the total hydration of lithium chloride ions R Trehin Complementary researches on the absorption spectra of sodium chloride in the ultra violet The absorption spectra show that there is a distinct difference between the nature of the absorbing particles in crystallised salt and in aqueous solution Salt solutions in glycerol were also studied Marcel Ballay The electrolytic deposition of nickel in media with *p*H higher than 7 0 Léon Piaux The Raman spectra of cyclopentanol of some alcohols derived from cyclopentene and of 1 cyano 1 cyclopentene A Michel Lévy and H Muraour Experiments in micropyrotechny The luminous phenomena produced by the detonation of a priming explosive (lead azide) are due to the wave of shock and not to the expansion of gas which succeeds it M Lemarchands and Mlle D Saunier The combinations of the metalloids and basic oxides Description of the properties of the compound Ag_2OI_2 prepared by the action of iodine in carbon tetrachloride solution on anhydrous silver oxide Pierre Dubois The thermal decomposition of manganous salts in a current of air H Pied and Mlle M Falinski Neutral zirconium nitrate Crystallised zirconium nitrate could not be prepared free from nitric acid but the application of the method of Schreinemakers gave results which left no doubt as to the existence of the compound $Zr(NO_3)_4.5H_2O$ Mlle Suzanne Hémar The blue basic carbonates of copper Georges Arragon The acetylation of sorbose in the presence of pyridine The substitution of pyridine for zinc chloride in the acetylation of sorbose gives higher yields of the tetracetate A Colani The combinations of uranyl oxalate with oxalates of the alkaline earths Sébastien Sabetay and Léon Palfray The extension of Cannizzaro s reaction to fatty and aryl fatty aldehydes A comparison of the authors' application of the Cannizzaro reaction with the hydroxylamine method of determining aldehydes Marius Badoche Researches on the dissociable organic oxides Ethyl 1 1 3 triphenyl rubene carboxylate $C_{26}H_{18}CO_2C_2H_5$ its dissociable oxide Edmond Urion Some reduction products of cyclopentenylformaldehyde Mme Guaisnet Pilaud A third hydrate of phenylmethylethyl betaine and its conditions of formation Henri Erhart The white earths of Lorraine their origin nature and natural use G Lucas Tectonic study of the north region of Medjana (Algeria) J Coulomb The beginning of Love waves Robert Lami The heterogeneity of some physical characters of coastal basins A Métral Clouds in bands Bogdan Varitchak The formation of organs of sexual reproduction in a species of the genus *Saprolegnia* in cultures *in vitro* The formation of the organs of sexual reproduction depends on the composition of the nutritive medium its hydrogen ion concentration and temperature Fernand Moreau and Mlle C Moruzi The sexual reactions between Ascomycetes of different species H S Reed and J Dufrenoy The histochemical detection of iron and zinc in the leaves of *Citrus* The disease known as mottle leaf in *Citrus* is amenable to treatment of the soil with zinc salts Micro incineration of the leaves according to Policard s method followed by microchemical analysis shows the distribution of the zinc in the tissues A Maige The physicochemical conditions of formation of the amylogen vacuoles in the plasts Raoul Lecoq and Jean Savare The rôle of the food equilibrium in the utilisation of castor oil by the organism H Bierry The preparation of protein sugar Mme Yvonne Khouvine The synthesis of cellulose by *Acetobacter xylinum* starting with polyalcohols containing C_3 C_4 C_5 C_6 and C_7 G Warcollier Aug Le Moal and J Tavernier The accidental presence of acrolein in cider brandy and pear brandy its formation at the expense of the glycerol N Stendal The presence of a glycol in the wax of the tubercle bacillus Description of the method of separation of a glycol phytoglycol $C_{22}H_{44}O_2$ the physical and chemical properties of which are given Maurice Piettre Physicochemical phenomena accompanying the physiological stimulation of the breast in females before the first parturition P Lépine and Mlle F Bilfinger The experimental infection of the louse by murin virus of the exanthematic type

Leningrad

Academy of Sciences (*Comptes rendus* n s No 4) V D Kupradze Integral equations for electromagnetic waves V Gogoladze Cauchy s problem for a generalised wave equation A solution of Cauchy s problem is offered V Kondratjev and D Eropkin Atmospheric band of water vapour 6324 A in the solar spectrum In the interval 170 A of the solar spectrum 235 new lines were found 109 of them being of considerable intensity As regards Rowland s lines many of them proved to belong to water vapour S Arzybyshev and A Toporez A new method for the determination of mobility of metallic ions in alkali haloid crystals N Dobrotin Angular distribution of protons ejected by neutrons A calculation made for $F(\psi) = \cos\psi$ shows that the data obtained are nearer to Curie s results (*Phys Rev* 44 1933) than to those of Auger and Monod Herzen (*C R Acad Sci* Paris 196, 1933) P Lazarev N Podzorov, E Jakovlev and L Kusminitch Researches on adaptations in peripheral vision during different stages of pregnancy The visual sensibility becomes depressed a few days before the end of pregnancy, and the depression reaches its maximum during labour After labour, the sensibility rises considerably I Tcherniayev and A Rubinstein The reaction of pyridine with Cleve's and Gerard's salts When pyridine reacts with Cleve's salt, a replacement of the molecules of ammonia by pyridine takes place, and $(PyCl)_2Cl_2Pt$ is formed In the reaction with Gerard's salt, pyridine replaces two ions of chlorine, with the formation of $(NH_3)_2(PyCl)_2PtCl_2$ The reaction with pyridine may serve as a qualitative test for these salts N Held and V Djachkov Studies in the adsorption of organic substances on crystal surfaces The adsorption of nonylic acid on barium sulphate proved to belong to the type of ionic adsorption A Studitskii The interaction of cartilaginous tissue and the periosteum and its rôle in the endochondrial process according to data obtained from grafts transplanted on to the allantois V Novikov, A Gretchushnikov and J Barmenkov The accumulation of rubber in the roots of *tau sagyz* as a result of its disappearance from the leaves B Licharev New genera of Upper Palæozoic Brachiopoda A P Vinogradov Origin of iodine and bromine in oil bearing waters D Kostov Polygeneric hybrids experimentally produced Experiments showed the possibility of obtaining trigeneric and tetrageneric hybrids of several species of *Nicotiana*

Comptes rendus, n s, No 5—I Vinogradov Trigonometrical polynomials for complicated moduli S Bernstein Diffusion with absorption V Kupradze The proofs of existence and of unity in the diffraction theory V A Fock Approximate representation of wave functions of penetrating orbits V Kuznetsov and D Saratovkin Contribution to the problem of the primary crystallisation of metals The orientation of monocrystals is accidental, and the probable orientation is characterised by the angles $\chi = 0°$ and $\chi = 30°$ P Budnikov Activation of the slags of blast furnaces and the preparation of clinkerless cement N Held and K Samochvalov Studies in the adsorption of organic substances on crystal surfaces (2) Influence of electrolytes on the adsorption of the octylalcohol by Ag_2S HgS $BaSO_4$, and of the nonylic acid by Ag_2S A Studitskii Conditions for the differentiation of the osseous tissue of a human embryo in grafts on the allantois I Kolomiez On critical period' in the development of wheat There is a connexion between the greatest sensitivity of wheat to a lack of moisture and the time at which the formation of the generative organs begins L Dobrunov Growth peculiarities of hemp as a result of a lack of nutritive substances in the soil

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Forthcoming Events

Wednesday, June 20

Royal Methorological Society, at 5—Sir Napier Shaw The Natural History of Weather'

I S Astapowitsch The Air Waves caused by the Fall of the Meteorite on June 30, 1908, in Central Siberia Dr F J W Whipple Phenomena related to the great Siberian Meteor"

Institution of Heating and Ventilating Engineers, June 18–20 Summer meeting to be held at Hastings.

Official Publications Received

GREAT BRITAIN AND IRELAND

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1557 (I C E 823 T V C 58) Effects of Friction in Airscrew Drives in Damping Torsional Vibration By B C Carter Pp 25+3 plates 1s 3d net No 1567 (Strut 122, 127) Flexural and Shear Deflections of Metal Spars (Part 1) By I J Gerard and H Boden Pp 11+20 plates 1s 6d net (London H M Stationery Office)

Proceedings of the Royal Irish Academy Vol 42 Section C No 3 A Wooden Cauldron from Altartate Co Monaghan By A Mahr Pp 11 29+plates 7 10 (Dublin Hodges Figgis and Co London Williams and Norgate, Ltd) 1s

Seale Hayne Agricultural College Newton Abbot Devon Department of Plant Pathology Tenth Annual Report for the Year ending September 30th, 1933 (Pamphlet No 42) Pp 39 (Newton Abbot)

A List of Official Chemical Appointments Compiled by direction of the Council of the Institute of Chemistry and under the supervision of the Publications Committee Eighth edition, revised and enlarged Pp 389 (London Institute of Chemistry) 6s

The Scientific Journal of the Royal College of Science Vol 4 Containing Papers read during the Session 1933 1934 before the Imperial College Chemical Society the Royal College of Science Natural History Society, the Royal College of Science Mathematical and Physical Society Pp 172 (London Edward Arnold and Co) 7s 6d

Annals of the Royal Statistical Society 1834 1934 Pp xii+308+8 plates (London Royal Statistical Society)

A List of International Fellowships for Research Second edition (revised and amplified) Pp 187 (London International Federation of University Women) 2s

Economic Advisory Council Committee on Cattle Diseases Report (Cmd 4591) Pp 161 (London H M Stationery Office) 2s 6d net

OTHER COUNTRIES

Mysore Geological Department Bulletin No 14 The Origin and Correlation of the Metamorphic Rocks of the Sakarsanhalli Area Kolar District By M B Ramachandra Rao and K Sripada Rao Pp iv+33+8 plates (Bangalore Government Press) 1 rupee

Dominion of Canada Department of Marine Radio Branch Supplement A to Bulletin No 2 Radio Inductive Interference By H O Merriman Pp 41 (Ottawa King's Printer) 15 cents

U S Department of the Interior Geological Survey Bulletin 846–D Some Lode Deposits in the Northwestern Part of the Boise Basin Idaho By Clyde P Ross (Contributions to Economic Geology 1933) Pp iv+239–285+plates 39–48 35 cents Bulletin 848 The Microscopic Determination of the Nonopaque Minerals By Esper S Larsen and Harry Berman Second edition Pp vi+266 20 cents Water Supply Paper 726 Surface Water Supply of the United States 1932 Part 1 North Atlantic Slope Basins Pp x+378 25 cents (Washington, D C Government Printing Office)

Forest Bulletin No 82 The Measurement of Standing Sample Trees By H G Champion Pp iii+17+5 plates (Delhi Manager of Publications) 1.2 rupees 2s

Koninklijk Vereeniging Koloniaal Instituut Amsterdam Drie en twintigste Jaarverslag 1933 Pp 96 (Amsterdam)

Smithsonian Miscellaneous Collections Vol 89, No 13 A Systematic Classification for the Birds of the World, Revised and Amended By Alexander Wetmore (Publication 3242) Pp 11 Vol 91 No 9 Reports on the Collections obtained by the first Johnson Smithsonian Deep Sea Expedition to the Puerto Rican Deep —Three New Deep water Fishes from the West Indies By George S Myers (Publication 3238) Pp 12+1 plate Vol 91 No 10 Reports on the Collections obtained by the first Johnson Smithsonian Deep Sea Expedition to the Puerto Rican Deep—New Brachiopods By G Arthur Cooper (Publication 3241) Pp 5+2 plates Vol 91 No 11 Reports on the Collections obtained by the first Johnson Smithsonian Deep Sea Expedition to the Puerto Rican Deep—Two New Nematodes By B G Chitwood (Publication 3243) Pp 4+1 plate (Washington D C Smithsonian Institution)

Chamber of Commerce of the State of New York A Report of the Special Committee on Immigration and Alien Insane, submitting a Study on Immigration Control By Harry H Laughlin Pp 51 (New York City)

Bulletin of the Earthquake Research Institute, Tokyo Imperial University Supplementary Vol 1 Papers and Reports on the Tunami of 1933 on the Sanriku Coast Japan Pp xii+271+250+251 plates (Tokyo Iwanami Shoten) 12 50 yen

The Upper Winds of Hong Kong from Observations made with Pilot Balloons 1921–1932 By G S P Heywood under the direction of C W Jeffries. Pp 13+18 plates (Hong Kong Royal Observatory) 2 dollars.

Research Activities of the National Research Council 1933 34 Pp 59 (Ottawa)

Department of Agriculture Mauritius Sugarcane Research Station Bulletin No 3 Some Preliminary Data concerning the Best Shape and Size of Plot for Field Experiments with Sugarcane By Dr H Evans Pp 11+2 plates (Port Louis Government Printer)

Publications of the Dominion Astrophysical Observatory Victoria, B C Vol 6, No 9 Spectrophotometric Studies of Wolf Rayet Stars and Novæ By C S Beals Pp 95–148 Vol 6, No 10 The Radial Velocities of 477 Stars By W E Harper Pp 151–202. Vol 6 No 11 The Spectroscopic Orbit of H R 8584 By W E Harper Pp 203–206 (Ottawa King's Printer)

The Indian Forest Records Vol 19, Part 9 Entomological Investigations on the Spike Disease of Sandal (19) On the Life History and Morphology of *Petalocephala nigrilinea* Walk (*Jassidæ*, Homopt) By N C Chatterjee Pp iii+30+2 plates. (Delhi Manager of Publications.) 12 annas, 1s. 3d

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Anthropological Method and Native Administration

FROM almost the earliest days of the scientific observation of peoples of backward culture it has been a commonplace of ethnographical literature to deplore the break up of custom under the impact of European civilisation This attitude of mind argues a certain confusion of thought It is unquestionable that the contact of an individualistic economic and social system such as that of Western culture with a native society in which the unitary character of the group whether of the family or tribe with its attendant aura of religious sanctions is paramount has rendered more difficult the task of the investigator of non European types of social institution and has caused the loss to science of data of high value for sociological studies but it has to be remembered that this very material of which the contamination is regretted does not probably in even a single instance represent a homogeneous or primitive cultural phase

The more intensive becomes the study of the character and make up of specific cultures the more apparent does it become that like the pure race in the classification of the varieties of mankind a primitive culture is an abstraction a logical postulate of sociological argument of which the material counterpart at this late date in the history of human development is never likely to meet the eye of the explorer Just as the existing races of mankind are the products of a long process of racial contact followed by opportunity for differential development so the forms of social organisation which have hitherto provided the subject matter of observation and record are the results of cultural contacts combinations of different strains of culture which have attained a certain measure of stability in a period of isolation partial or complete

The disintegration of native custom is no new thing In modern times it differs from previous manifestations of the effect of a clash of cultures whether inferred from cultural analysis or recorded in history only in the rapidity with which it is taking place and in the greater disparity of the conflicting elements Even the latter factor may be too strongly stressed It is indeed difficult to gauge the degree to which the present break up of custom is more intense than those of the past How great for example must have been the dislocation which resulted from the disparity in culture when a sedentary agricultural people of settled habits was overrun by a tribe of war-like nomad pastoralists. The results may be seen in the anomalous social groupings which followed on the Aryan invasion of India or the spread of pastoral peoples over agricultural Africa. As a more familiar, if less extreme, example may be taken the change in social and economic organisation which supervened on the incursion of the Saxons into a Britain the inhabitants of which had attained a nice adjustment of tribal life to their capabilities in exploiting the land, or had become partially urbanised.

Where there has been a default of written records, these and similar hybrid cultures have had, perforce, to be studied each as an integral complex. Their previous history has been purely a matter of inference. As time goes on, however, there is a steadily increasing number of peoples of whom it is possible to say that there are records to show that their culture is no longer as it was first seen or described by the white man. For example, a recent account of female initiation in an African tribe records evidence for no less than four modifications of ceremonial within living memory ("Valenge Women". By E. Dora Earthy. London, 1933.) The fact that the evidence for these modifications was afforded by native record does not affect the principle. For the present purpose the important point is that, so far as such cultural modifications may be regarded as corruptions of custom due to European contacts and therefore of negligible interest to the science of anthropology—as contrasted with forms of institution and belief recorded at the point of earliest contact—there is danger that the academic study of man may be divorced from actual conditions, to the detriment of the science as an aid in practical affairs.

For many years British anthropologists have urged that some knowledge of the principles of anthropological science is an essential element in the training of those who are to enter into official relations with the backward peoples of our dependencies, and a practical necessity in the successful administration of native affairs. Unfortunately, human nature is not cut to pattern and the application of general principles to cases in, let us say, the heat of conflict between custom and authority has proved on occasion by no means so simple a function of the spirit as it may have seemed in an academic atmosphere. As a matter of experience, it has been found that to think out, or to inquire into the implications of custom in the light of scientific principles, makes a greater demand on the time and the mental flexibility of an already heavily burdened official than it is possible always to meet.

Under the administrative system known as 'indirect rule' the knot has been cut, as indeed was inevitable to meet the needs of the situation by a direct record of law and custom as a working organism; but such a record, however strictly the collection of data has conformed to the canons of scientific method, in so far as it is 'particular', is the raw material of anthropological science rather than a contribution to the scientific study of man as such. Nothing is added to the interpretation of general principles for the use of the administrator outside the immediate sphere of reference. The indisputable scientific value of the official records from West Africa and New Guinea, in the form in which they have been given to the public, is due to the non-essential fact that the collection of the data has been entrusted to officials who happened also to be trained anthropologists.

The ultimate aim of indirect rule is too big a question to raise here. It must suffice to point out that, for the present purpose, it may be regarded as static and conservative. In other areas, in which methods of administration have developed out of a traditional native policy—too often, perhaps, a lack of policy—however much heed may now be given to the preservation of native custom making for stability, there has been a steady drift towards the disintegration of native modes of life. This was an inevitable result of the conditions of white settlement and the exploitation of tropical and sub-tropical lands. Further, in times of stress, native institutions are apt to be set on one side, even when the subject of a pledge, as happened, for example, in the instance of the Kakamega goldfields in Kenya.

In these circumstances, it must be patent that the academic study of the science of man—more particularly of man as a member of an organised society, the subject matter of social anthropology—tends in an increasing degree to lose touch with the everyday problems of native life and administration. In academic studies, material recorded thirty or forty years ago may, and in nine cases out of ten will, have a greater significance than the conditions of to-day. For the administrator, the position is reversed. While it may be eminently desirable that he should have in mind the history of an institution, the important point for his present purpose is the modified form assumed by, say, the chieftainship, or the tenure of property within the family, as a result of the contact of members of the tribe or family group with white civilisation, and the social and economic conditions which have been introduced thereby Still more is it important that he should be able to gauge the course of further development by consideration of analogous conditions elsewhere

Anthropologists in the United States have not been slow to grasp the implications of the changes which are taking place universally in the conditions of life among backward peoples They are now turning their attention to the special methods of inquiry which these conditions demand Dr Margaret Mead, in her book "The Changing Culture of an Indian Tribe" (New York, 1932) has attacked the problem of the outcome of cultural contact on lines which, in part at least, belong to the methods of sociology rather than anthropology Her work, however, points the direction in which a novel technique covering the methods of social studies and cultural anthropology must be developed to meet the special type of problem arising out of the growing industrialism of countries such as India, China and Japan, in which indigenous culture and the conditions of the modern factory worker meet and react

Fortunately for the anthropologist, progress among the majority of peoples of non European culture has not gone so far as to require that he should summon to his aid and adapt to his needs the special methods of sociological investigation in an industrial civilisation The extent, however, to which changing conditions impose a modification of method and outlook upon the investigator who seeks to gauge the tendencies of development where there is a conflict of the two diverse cultures of the so called 'primitive' and civilised worlds, may be estimated from certain recent publications, of which two are by an American investigator and one by a British anthropologist[*] These three publications, though dealing with very diverse and widely separated peoples, nevertheless may legitimately be grouped together in virtue of a certain community of view They mark a change in the orientation of research and, it would seem, open a new chapter in the literature of ethnography

Dr Keesing's valuable study of present-day Samoa and his no less valuable account of his investigations among the hill tribes of Luzon, in which he gives special attention to the achievement of the United States administration, serve to illustrate the application of anthropological method to the diagnosis and treatment of current difficulties His study of Samoa is particularly instructive, for his sketch of native culture as it was before modification by European control shows how far the troubles, which have kept Samoa 'in the news' for so long, were due to a failure to understand the specific character of Samoan social organisation

Dr Mair's study of Uganda stands in a somewhat different category, but her appointment to the recently created lectureship in Colonial administration at the London School of Economics gives it an added interest Forty years ago the Baganda were what it was then fashionable to call 'naked savages', albeit they had a very fairly well-developed culture of their own To-day they dress in European clothes and ride bicycles, but their problem is still to a large extent unsolved How far they have progressed and the direction, may be gauged by Dr Mair's observations on the people and their reactions, and by contrasting them with the record made by the Rev John Roscoe more than thirty years ago

In relation to the more general question, it is perhaps permissible to suggest here that Dr Mair's experience in the field will afford her the basis for developing her academic function in the direction of making her lectureship a link between the more academic side of anthropology and the scientific study of, and formulation of a practical policy in relation to, the changing habits of a people in the throes of a cultural conflict

The present trend of development among peoples of backward culture, therefore, would seem to be leading in anthropological studies in relation to practical affairs to the old and familiar conflict between the 'man in the armchair' and the 'man on the spot', who claims an intimate acquaintance with conditions as they are and, therefore, assumes the sole right to decide upon them Unless the science of anthropology, as understood academically, is prepared to adjust its outlook and to revise its methods to embrace the dynamic as well as the static elements in culture, it is by no means certain that, as in the past, the advantage will be with those who rely on the results of academic training

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[*] (1) Modern Samoa its Government and Changing Life By Dr. Felix M. Keesing. Pp. 506 (London George Allen and Unwin, Ltd., 1934.) 16s net.
(2) Taming Philippine Headhunters a Study of Government and of Cultural Change in Northern Luzon. By Dr Felix M. Keesing and Marie Keesing. Pp. 288. (London George Allen and Unwin, Ltd., 1934.) 10s. 6d. net.
(3) An African People in the Twentieth Century By Dr L. P. Mair Pp. xvi+300+11 plates. (London George Routledge and Sons, Ltd. 1934.) 12s. 6d. net.

Art, Science and Morality

Beauty and other Forms of Value By Prof S Alexander Pp x+305 (London Macmillan and Co, Ltd, 1933) 10*s* 6*d* net

IN this work Prof Alexander has applied what Hume called "the experimental method of reasoning" to the investigation of the whole range of values Both the origin and the nature of beauty, truth and goodness are to be understood by considering how human beings came to value them for their own sakes and what human impulses produce them The sciences of value are, as Hume thought they were, sciences of human nature' Their method is psychological and anthropological The differences between the higher or intrinsic values are to be explained as due to the different ways in which a human individual reacts contemplatively' to his natural and social environment, complicated by his instinctive need for conformity with his fellows To account for the opposition between value and dis-value which is found in each of the spheres of art, science and morals, we have to recognise that judgments of value are not purely subjective, but are relative to the 'standard mind' of any given society The measure of the truth of value judgments is neither to be found in any a priori principles apprehended by reason nor in characters which belong to the object valued independently of the evaluator, but in the representative man who embodies the prevailing taste of the society in which he lives Thus in order to account for the existence of standards of value, we do not need to abandon the 'experimental method' or the point of view of human nature Anthropology and sociology will explain, where individual psychology cannot, how standards of value originate, compete and come to prevail

The same method was applied by Prof Alexander to reach very much the same results in "Space, Time and Deity" The most notable feature of the new work is a much more developed and complete exposition of his theory of beauty, which occupies the first half of the book Truth and moral goodness are then briefly elucidated by considering the resemblances and differences between them and the value of fine art, and the 'lower' values of satisfaction in man and the animals are treated finally in relation to, and in contrast with, the 'higher' values

The values of beauty, truth and goodness are not, in Prof Alexander's view, qualities of the objects to which we attribute them He describes them as "relations" between the objects which are called valuable and the evaluator They are "tertiary" or relational qualities which are experienced as the satisfaction by the relevant objects of certain specific impulses in the mind when these have become, as Prof Alexander puts it, "contemplative" Thus beauty consists in the satisfaction of the constructive impulse, truth in the satisfaction of curiosity, moral goodness in the satisfaction of the social impulse In becoming contemplative' these impulses are gratified for their own sake—not in the ordinary course of ordinary practical living—through the creation of a new product (a work of art in the case of beauty an organisation of our passions and desires in the case of moral goodness, a scientific theory in the case of truth), which would not have existed but for the interference of the human mind with Nature These products are created by the corresponding impulses for their own satisfaction, and with them the mind enters into a peculiarly intimate relation which confers value upon them The higher values are thus relative to the mind, but they are not, Prof Alexander insists, subjective, they are objective in the sense that they are relative to a 'standard' or typical mind

Prof Alexander's presentation of his case is intentionally descriptive rather than critical or controversial This has its advantages as well as its disadvantages Throughout the book he is anxious to let the facts speak for themselves and not to twist them in the interests of a metaphysical theory The results of this are particularly valuable in his discussion of beauty, which is happily free from the vagueness and obscurity which are so common in the writings of philosophers on this subject His theory of artistic value, which it is unfortunately impossible to discuss here in detail, is without doubt the most important contribution that any British thinker has made to the study of æsthetics in the present century The same scrupulous respect for fact and sensitiveness to Nature in the concrete which influences his whole treatment is reflected in a singularly vivid and charming style, which is not content merely to describe and analyse, but goes on to present or re-create poetically the facts which he seeks to explain.

It is at the same time doubtful whether Prof Alexander's adoption of a psychological or anthropological method can be justified, and his theory of a 'standard mind' as the basis of our judgments of value made convincing, without a more critical defence of his general point of view than he has given. If the 'standard mind' represents the average level of opinion in any given society about what is true or good or beautiful, it is hard to see what authority it can claim for its verdicts. If, on the other hand, it represents the opinion of the 'expert' in science, art or morals, it must be pointed out that we submit our opinion to the expert's judgment because he knows what really is beautiful or true or good. The expert's judgment is authoritative not because it constitutes the standard but because it conforms to a standard which is 'objective' in the sense that it is independent of human opinions and tastes. Unless our standards of value are objective in this sense, it is hard to see how either progress or retrogression as opposed to mere change, in art, science or morals is possible, or how the question whether the civilisation of one community is or is not superior to that of another which differs from it can have any real significance. If there is any force in these objections, it will follow that the naturalistic method cannot explain what values are, though it may account for their origin and development in relation to the individual or the social group.

Termites and their Control

Termites and Termite Control: a Report to the Termite Investigations Committee. A Discussion of the Biology of Termites, and an Account of the Termites of the United States, Mexico, the Canal Zone, the West Indies, Hawaii and the Philippine Islands, with Recommendations for Prevention and Control of Termite Damage by Methods of Construction and the Use of Chemically Treated and Unpalatable Woods. Editorial Board:—Prof. Charles A. Kofoid (Editor in Chief), Prof. S. F. Light, A. C. Horner, Prof. Merle Randall, Prof. W. B. Herms and Earl E. Bowe. Pp. xxvi+734. (Berkeley, Calif.: University of California Press; London: Cambridge University Press, 1934.) 22*s*. 6*d*. net.

A REPORT of a local committee in San Francisco in 1927 attracted attention to the great damage done by termites in California. The public was alarmed and funds were quickly subscribed by various interests to finance an investigation committee, the report of which has just appeared. It is an elaborate work, the result of the collaboration of thirty-four authors, under a board of six editors. The board of directors of the committee consisted of twenty-four members, operating with thirteen sub-committees.

Although we are exempt from the attention of these insects in Great Britain and only two species are known in Europe, there are no less than fifty-five in the United States, the greater part of which are concentrated in the Pacific coast, thanks to the genial climate and contiguity of the neotropical region. Altogether, about fifteen hundred species are known; twelve hundred of these form the family *Termitidæ*, which are dominant in the tropics, but do little damage. They are rather beneficial to human interests, in spite of their undeservedly bad reputation.

There remain three hundred species divided into four subfamilies which never rest in their function of breaking up cellulose and returning its elements to the atmosphere. Termites are among the few creatures that can digest this refractory material, which they do with the help of an abundant fauna of Protozoa in their intestines.

It is noteworthy that these do not occur in the *Termitidæ* which, living mainly on vegetable detritus, do not require their services. In some genera and even subfamilies, it appears that each species has a characteristic fauna; consequently their Protozoa are a great help in the identification and classification of the termites.

Further, H. Kirby has established the extraordinarily significant fact that similar Protozoa are found in the wood-boring cockroach *Cryptocercus punctulatus* and that in the cockroaches the flagellate genus *Trichonympha*, which is widely distributed among the termites, is represented by several species. This is striking evidence in favour of the accepted view that the termites branched off from the ancestral cockroach towards the end of the Palæozoic era.

Their natural function as destroyers of cellulose brings termites into antagonism with man. It is estimated that the damage done by termites in the United States amounts to no less than 37,000,000 dollars per annum, three quarters of which is in the southern and western area. All wooden structures are mercilessly attacked—power transmission, telegraph and telephone poles, timber stacks, wooden buildings, and interior wooden structures, even furniture.

The use of steel for telegraph poles and railway sleepers, and increased use of cement in building, have reduced termite damage substantially in the tropical parts of the British Empire, but the actual and potential importance of the creature is so great, and so little investigation has been conducted into the problem, that this important work should be welcome to architects, surveyors, engineers, indeed by all users of wood in the tropics, where it is estimated that termites add 10 per cent to the general cost of construction

The two methods of attack are construction and treatment Owing to the diversity of habits of the creature, the first need is to study the local termites and adapt methods accordingly As an example of construction may be mentioned the raising of woodwork above the ground so as to eliminate moisture and prevent attack by those species which do not make runways

A long series of laboratory experiments has shown that treated wood is proof only if rendered toxic The most satisfactory results were obtained with copper sulphate, sodium chloride and zinc chloride Paint is only a deterrent, fumigation and ground treatments are unsatisfactory, the best results against dry wood termites were obtained by the use of poison dust as Paris green arsenical smelter dust and finely ground sodium fluosilicate The extract of American redwoods, sequoyin and isosequein two newly discovered substances with remarkable properties, were found to be highly toxic to termites

Architects will find great interest in the last chapter with recommendations for construction, for inspection and maintenance, for preventing and repairing damage It is to be noted that the engineer must often rob Peter to pay Paul, as construction and maintenance may be in conflict

Conditions are so varied that no golden key can be found, but it seems that the impregnation of wood with coal tar creosote by pressure treatment gives the most lasting and satisfactory results under severe conditions As wood frame construction has been recommended as the best design for resistance to earthquakes, it is especially necessary to take adequate action against these pests in regions so liable

The work is placed upon the market at a minimum price, and results of sales will be applied for the benefit of further research The biological portion is of very great interest to entomologists and is a notable addition to the literature of the subject, but the practical portion, on which the existing literature was quite inadequate, is of great value to all architects, engineers and users of wood engaged in construction in all tropical, and many subtropical, countries, and consequently of definite moment to officials and settlers in our African, Oriental and Australian dominions and territories

M B

Industrial Organisation

The Logic of Industrial Organization By Dr P Sargant Florence Pp xi+280 (London Kegan Paul and Co Ltd, 1933) 10s 6d net

FROM the author of such a work as the Statistical Method in Economics" previously reviewed in these columns, one confidently looks for a clear and orderly presentation of the relevant facts and logical deduction therefrom and in this latest book by Prof Florence one is not disappointed His main purpose is an examination of the structure and functioning of modern industry to show how this structure and its working are for the most part anything but logical or even properly organised, and to suggest methods for remedying this serious defect

At first sight one might suppose that the ideal of organised industry is that of a perfectly designed and constructed machine which, despite its almost infinite complexity, functions with the cold precision of a highly efficient machine on a thoroughly logical production schedule One might suppose further that, if this ideal be completely realised then the mechanisation of industry of which we hear so much would indeed be advanced to a terrible and ruthless stage, both literally and metaphorically not only would industry throughout its entire length and breadth use the most efficient mechanical means available in all its operations but industry itself would also be closely akin to a huge complicated yet perfectly designed mechanism, and the evils of modern industry would be intensified a hundred fold If, for example, we already get over-production and under employment owing to the increased efficiency and output of machines, to what almost inconceivable extent would this strangely combined excess of one and defect of the other be carried if industrial organisation itself could be likened to a giant machine of maximum efficiency ! Of course if this ideal could be properly realised it might mean the total elimination of unemployment in some mysterious way that we cannot foresee, but this is most unlikely However, such realisation is a very long way off, as this work clearly shows, and in any event this conception of industry as a huge soulless machine is certainly not that of the author

Most emphatically no, for the human or psychological factors of modern industrialism are here given full weight and first consideration The worker is not to be sacrificed to mere output, even if he were a willing victim of such immolation, and the enlightened employer realises more and more clearly that, even from the point of view of maximum production if not from the higher humane and moral point of view, the workers must be treated as men and fellow creatures as members of one great brotherhood. If he does not realise it, then the workers very soon make their point of view clear to him and refuse to be exploited. In the present book one of the most valuable and interesting chapters is that dealing with labour stimulus and incentives in which special emphasis is laid on those fundamental characteristics of human nature which so largely determine a man's attitude to his work and his reactions to the conditions of employment.

The aim kept in view throughout the book is that of industrial efficiency defined as maximum return—physical, pecuniary and psychological—at minimum physical, pecuniary and psychological cost, and a fairly thorough study is made in general terms of modern industry in Great Britain, with frequent references to Germany and the United States. A rapid survey of the whole subject matter may be readily obtained from the 'Conclusions' concisely stated in chap. ix, and one can readily see from a good index that among the many vital topics dealt with, administration and training for same, capital and investment, directors and their methods good and bad, labour and work conditions, transport, and so on, are fully treated.

The part played by education and training in industry is to-day of particular importance and the author's criticism of English education from this point of view, though severe, will scarcely be deemed too drastic. He thinks that our educational system requires radical alteration if it is to help in supplying efficient industrial administrators. On the subject of unemployment the chief suggestion appears to be a more logical distribution of work, mainly by shorter hours, but this bald statement scarcely does justice to the author's contribution to this burning question of the hour. Chap. iv, dealing with investment, employment, management, deserves close and careful reading. Indeed, this applies to practically the whole work, for it sticks closely to the facts of our everyday working life, wastes few words on theorising or philosophical speculations, is nothing if not logical, and is for the most part in the straightforward indicative mood, though the optative—as with any humane writer however factual or statistical—must obtrude now and then.

Plant Analysis

Handbuch der Pflanzenanalyse. Herausgegeben von G. Klein. Band 4: *Spezielle Analyse.* Teil 3: *Organische Stoffe III. Besondere Methoden, Tabellen.* Hälfte 1. Pp. xii+838. Hälfte 2. Pp. vi+839–1868. (Wien und Berlin: Julius Springer, 1933.) 198 gold marks.

THE two volumes now under notice complete this comprehensive work which has already been noticed in NATURE (130, 617, Oct. 22, 1932; 131, 8, Jan. 7; 132, 584, 1933). They deal, in the first volume, with the amino acids, amides, amines and the betaines, all written by Dr. A. Winterstein, the proteins compiled by Bergmann and Zervas, nucleins by Steudel and Peiser, alkaloids by Seka, cerebrosides by Thierfelder supplemented after his decease by Klenk, all being authorities of repute. In the second volume, Dr. Sjöberg discusses enzymes in general whilst Dr. Ziese deals with them in detail. The plant antigens are described by Eisler, the plant hormones by Loewe, plant vitamins by Winterstein.

A final section deals at length with special methods of biological analysis, soil analysis; it has a chapter descriptive of the various fermentation processes by Kobel and Neuberg, another handling the nitrogen balance and a very valuable section on plant pigment analysis by chromotographic adsorption methods by Winterstein.

The work concludes with more than 300 pages of tables and index in which all the known plant constituents are listed in alphabetical order with their formulæ, physical constants and solubility.

The above details indicate merely the wide scope of the work, so that it is necessary to testify also to the thoroughness and completeness with which the respective subjects are put on record.

Since our previous review was written, we and several of our younger colleagues have had opportunity to make frequent reference to the earlier volumes which have proved to be of the greatest use; it is only fair therefore to accord to Dr. G. Klein, the editor in chief of the monumental work, the appreciation of those who are working in the field of plant chemistry. It is one which for some time past has been largely neglected, in part owing to the superior attraction offered by problems in animal chemistry, especially the vitamins; but there are signs of a change in fashion, and the problems of the plant are now attracting the attention of many of the younger workers. To them such a summary at the present time is of importance not only for the information it contains, but also because it is definitely stimulating in indicating the loopholes and the possibilities for new work

A word of praise must be given also to the publishers for their enterprise, even if tempered with some expression of regret at the price which is charged Expressed in our currency, the cost puts the ownership of the book outside the reach of all but the most wealthy library, whereas it ought to be widely available for reference purposes

It is obviously out of the question to attempt any detailed analysis, rather must the book be viewed as a whole, as a record of the present state of knowledge of plant products discovered by the organic chemist Very nearly all the substances have yielded to his artifices, many only during the last decade, in spite of their complexity, fats, sugars including starch and cellulose, the proteins, alkaloids, saponins, nucleic acids, the plant colours, all have their secrets laid bare—only a few details as to their configuration are withheld The attack is now on the most complicated constituents of the cell, on the ferments, the hormones and the more complex proteins Here and there may be found isolated compounds to be investigated among the glycosides, the arrow poisons or elsewhere, but the time has come to establish group relationships, to correlate structure with physiological activity, to seek the origins and the function of compounds of such complexity in plant life

Had the achievement been a literary one, there would have been the excuse to rhapsodise over its greatness, to bestow laurel crowns, but in science it is otherwise—we are accustomed to pass quickly from the problem solved to the many more which await us, each new worker taking up the torch from the fallen, content to add his mite to the general store of advancing knowledge

E F A

Short Reviews

Weather the Nature of Weather Changes from Day to Day By the Hon Ralph Abercromby New edition, revised and largely rewritten, by A H R Goldie Pp xii+274+8 plates (London Kegan Paul and Co, Ltd, 1934) 10*s* 6*d* net

THE original edition of this work by the Hon Ralph Abercromby appeared in 1887 and attracted much attention, passing through seven editions without change Abercromby set out very effectively the principles of synoptic meteorology, and his generalisations and ideas have become classical The early hopes of forecasting weather from the travel of cyclones and maps of limited area were not, however, realised, and it is now accepted that 'the whole world is the meteorologist's laboratory' In the new edition, Mr Goldie has developed the physical principles and included present-day knowledge of the upper air and modern theories A recent weather chart of the northern hemisphere shows the enormous advance which has been made in organising observations

The book is fully illustrated and includes some fine cloud photographs, and these are discussed in relation to the synoptic charts Bibliographies are given which cover matters that could not be treated completely in the text Many interesting examples of weather are described in detail with the help of charts and diagrams The style is clear and will appeal to the general reader as well as the student Almost every aspect of the subject is discussed, including the Bergen theory of cyclones, the relation of wind to pressure distribution, line-squalls and thunderstorms, visibility and fog, tornadoes and the general circulation—all matters of great practical importance

АТОМНОЕ ЯДРО (*The Atomic Nucleus*) Edited by M P Bronstein, W M Dukelski, D D. Iwanenko and U W Khariton (Problems of Modern Physics, No 24) Pp 227 (Leningrad and Moscow Izdatel'stvo, 1934) 3 rub

THIS book (in Russian) consists in the main part of the description of papers, which were contributed to the First All Russia Atomic Nucleus Congress held in Leningrad on September 24–30, 1933, together with some of the discussions that followed Eleven papers are included

The contents start with a paper by F Joliot on neutrons, which is a summary of present-day knowledge of neutrons, description of the methods of production and conditions of their emission, and finally a discussion of their possible mass Then follow two rather theoretical papers by F. Perrin and D. Iwanenko on the constitutive parts or units in atomic nuclei After a paper by D Skobeltzyn on the problems of cosmic rays, positron theory is discussed in two papers by P A M Dirac and F Joliot

Methods used for obtaining high speed electrons and ions are described by K. Sinelnikow, particularly the methods in use at the Ukraine Physico-Technical Institute in Kharkov, where an impulse generator of 1 5 millions volts produced electrons fairly readily with the speed of 1 3 million volts

There are also papers by L Gray, S Frisch and F Rasetti

The last paper, by A Leipunski, deals with the breaking down of atoms and gives a summary of recent work done by Lord Rutherford and co-workers

Coast Erosion and Protection By the late Prof E R Matthews Third edition revised, with an additional chapter and an appendix, by Dr Brysson Cunningham Pp xviii+228+36 plates (London Charles Griffin and Co, Ltd, 1934) 12s 6d net

THIS work, which is the third edition of the late Prof Matthews's book on coast erosion and protection, consists very largely of a record of the long experience of the author in dealing with these problems It deals with the erosion and accretion that is taking place around the coasts of Great Britain and with the various types of sea defences, the merits and defects of each type being discussed in detail There is some discussion of the action of sea water on concrete, while the effect of harbour projections on the travel of sand and shingle is briefly referred to The present edition also contains a chapter on recent practice by Dr Brysson Cunningham, and an appendix giving the conclusions on coast protection drawn up for the International Association of Navigation Engineers in 1931

The book is based mainly on papers read by Prof Matthews before various learned societies and articles contributed by him to technical journals at different times These have been collated and are presented in a somewhat disjointed form The illustrations are lavish There are many useful detailed sketches of existing sea walls, groynes and breakwaters and a very large number of photographs, excellent in their way but of no particular technical value, illustrating the breaking of waves on sea walls and breakwaters, cases of cliff erosion, and the like As a record of the personal experience of Prof Matthews, the book should be of use to the engineer engaged in similar work

Biologie der Tiere Deutschlands Herausgegeben von Prof Dr Paul Schulze Lieferung 36 Teil 26, *Orthopteroidea* I Von Max Beier Pp 231 (Berlin Gebrüder Borntraeger, 1933) 16 gold marks

THE present part of this work contains three chapters respectively on the Blattoids (cockroaches), the Dermaptera (earwigs), both by M Beier, and on the Mantids (praying insects) by M Beier and J Jaus The longest of these is the first (116 pp) which forms an admirable account of the external features, internal anatomy, life-history and physiology of the cockroach, based chiefly on *Phyllodromia germanica* Particular attention is given to the structure and physiology of the nervous system and the alimentary tract The account forms an excellent source of reference for information, brought well up to date, on this much used laboratory type

The description of the earwig (63 pp) based chiefly on *Forficula auricularia*, which will also be useful to British students, follows similar lines with the addition of a short section on the chromosome numbers—$22+2x$ in female and $22+xy$ in the male and on the variation in size in the cerci

The chapter on the Mantids, largely on *Mantis religiosa*, directs attention to several special features of interest, for example, the pigment change in the compound eyes in the evening, the chromosome constitution of male and female, neoteny and regeneration

The illustrations of all the chapters are well chosen and admirably reproduced, and to each chapter a useful bibliography is appended

The Statesman's Year Book Statistical and Historical Annual of the States of the World for the Year 1934 Edited by Dr M Epstein Seventy first Annual Publication Revised after Official Returns Pp xxxiv+1478 (London Macmillan and Co Ltd 1934) 20s net

AGAIN this invaluable work of reference provides not merely a statistical guide to the countries of the world, their area, population, production, trade and finance, but also an epitome of almost every aspect of public life The arrangement follows the usual plan the British Empire with nearly a third of the book followed by the United States dealt with as a whole and then by each State in turn, and finally other countries arranged alphabetically with the overseas possessions belonging to each All the figures have been revised by the latest returns available A year that has seen turmoil in several States has not witnessed any material changes of boundary The adjustment between Iraq and Syria is shown on one of the two maps the other of which illustrates the progress of French civil administration into the interior of Morocco during recent years The introductory tables, which might well be increased in number if space allowed, give the world's production of petroleum, iron and steel, cocoa gold and cotton and the world's fleets and mercantile marines There is a summary of the work of the League of Nations

The Kinetics of Reactions in Solution By Dr E A Moelwyn Hughes Pp vii+313 (Oxford Clarendon Press, London Oxford University Press, 1933) 15s net

A GENERATION back the application of the kinetic theory to chemistry was restricted to the reactions which occur in gases Progress has enabled reactions in solutions to be examined in the light of the same theory with satisfactory results The author has selected certain representative examples for his purpose and has produced a treatise which will undoubtedly be of value to the advanced student and worker in physical chemistry The scope is best illustrated by the table of contents, the respective chapters deal with the collision theory, the Arrhenius equation, a comparison of the kinetics of reactions in the gaseous phase and in solution, and then pass on to bimolecular and unimolecular reactions, equilibria, ionic, catalysed and heterogeneous reactions

Fifty Years Ago, in the Royal Society of Edinburgh[*]

By Prof. D'Arcy Wentworth Thompson, C.B., F.R.S.

THE Royal Society of Edinburgh was a hundred years old just fifty years ago. We are looking back across those fifty years as on a remembered road whereon we all have travelled. Let us step across Princes Street and pay a visit to the former habitation of the Society.

We pass through a vestibule and enter those beautiful apartments, one opening into another, at which some of us still glance enviously through the tall pillared windows at the foot of the Mound. In the first room surrounded by books at a table which we use still an old man sat reading all day long. It was said of him that few men had absorbed more learning and exuded less! He was the Society's librarian Mr. James Gordon. He wore a long, wide skirted frock coat and a black satin stock came close up to his clean shaven chin. He had a shy but dignified manner and a hesitation almost a stammer, in his speech. He wrote the easy, fluent sonorous Latin of the cosmopolitan scholar and loved to write addresses to be sent abroad to some university or academy. He wrote such a one when Wyville Thomson went to Uppsala for the Linnean Centenary in 1878, and I remember hearing Wyville tell how much it had been admired by the Swedes. So we looked for it the other day and found it in our minutes: *Amplissimis Curatoribus, Rectori Magnifico, Doctissimoque Senatui Universitatis Upsaliensis* — and so on!

In the next room, a long and beautiful room, our meetings were held. Five large windows looked out on the Castle and the Gardens; but the meetings were at eight o'clock, and the curtains were drawn. Opposite the windows the bookcases were kept low, and there the portraits hung:—our Walter Scott, and Sir James D. Forbes, and Sir David Brewster, and Sir T. Makdougall-Brisbane, and Raeburn's portrait of old John Robison, and later on George Reid's portraits of Christison and of Tait. Half way up the room, on the window-side, was the president's chair, raised a little, and the table where (as now) the secretaries and other officers sat. On the far side, looking down the room towards the entrance, Tait sat for nearly forty years. I think of Crum Brown, wearing his little velvet cap, sitting beside Tait; of Buchan, at the opposite corner, stroking now and then his long red-brown beard; and Kelvin's eager restless figure in the chair.

Let us recall a certain older meeting, of not fifty but sixty years ago, sixty years almost to a day. David Milne Home was in the chair, and papers of the usual kind were being read. George Forbes (to-day the oldest of our fellows, save one), son of Tait's illustrious predecessor, talked of an optical illusion which Tait had noticed one sleepless night. Edward Sang had something to say on the properties of fluid drops within crystal cavities; and then a paper was read by a young author, rather a dull paper, on the "Thermal Influence of Forests". It dealt with the island of Malta, where the chairman had a scheme for the planting of trees. It made a good show of meteorological learning, quoting Réaumur, Humboldt, Becquerel, Boussingault, and Scoresby Jackson's "Medical Climatology". Its style was technical and scientific rather than literary:—"In addition to the ordinary hours of observation special readings of the thermometer should be made as often as possible at a change of wind, in order to admit of the recognition and extension of Herr Rivoli's comparison" —and so on. It was almost the first thing the author ever published, and the only scientific thing he ever wrote. He did better, much better, later on, when he wrote a book called 'Treasure Island'!

Two events influenced our Society and the scientific world of Edinburgh fifty and sixty years ago. One was the return of the *Challenger* Expedition; the other was the publication of the famous ninth edition of the "Britannica". Just as Robison and Playfair and Brewster and Dugald Stewart, and other members of our young Society, had been contributors to earlier editions, so fifty and sixty years ago, under Baynes and Robertson Smith, scientific Edinburgh was kept busy writing articles, and who should do this and who should get that was discussed eagerly. I can remember a little outburst of Tait's when "Astronomy" went to a certain popular writer whom Tait held to be outside the pale! But soon afterwards, Clerk Maxwell drew up a scheme for the chief scientific articles, and began by writing the article "Atom", in which Kelvin's vortex atoms, by the way, had full justice done them; and then he wrote his beautiful article "Capillarity"; and Tait wrote on "Light" and on "Mechanics", and Chrystal wrote famous articles on "Electricity" and "Magnetism"; and Crum Brown wrote a most original article on "Molecule". Besides these and such as these, there were endless biographical articles: Tait's on Sir Wm. Rowan Hamilton among the chief, and Chrystal's on Pascal, Poisson, Riemann and many more. It was a busy time when all these were being written.

As the Encyclopaedia brought the learning of Great Britain to an Edinburgh printing house, so did the *Challenger* Expedition make Edinburgh a centre for the naturalists of the world. Wyville Thomson was a weary man and out of health when he came home from the sea, and he died before his work was done. John Murray, the strong, able man who took his place and filled it bravely, has overshadowed Wyville's name and memory, but we few who knew him hold him in honour and affection. He had begun as a boy-naturalist by the East Lothian shore, as did old Sir John Graham Dalyell and Francis Maitland Balfour and many and many another. He came under the potent influence of Edward Forbes, who, with Goodsir, was the first to borrow the oysterman's dredge and begin the endless task of the exploration of the sea. With Carpenter, Wyville explored our western waters in the *Porcupine*, and made the cardinal discovery of the warm and cold waters of the Faeroe Channel, on either side of the submarine ridge which bears his name. We owe to him the grandiose conception, the splendid programme and the immense achievement of the *Challenger* Expedition, and the planning on a noble scale of the publication of its results. He saw before he died a few parts of the great publication.

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[*] Part of an address delivered in Edinburgh on Monday, May 7, 1934, on the occasion of the Society's hundred and fiftieth anniversary.

Wyville Thomson was a kindly man and faithful to his friends. He would search all Europe and America too to find the best man to deal with this group of animals or that, but if he found no such specialist he would pick out some friendly naturalist at home or some young pupil of his own. So he gave a certain large group to a very young student, my school fellow Willie (afterwards Sir William) Herdman; and Herdman brought his first reports before this Society and became in time the chief authority on the Tunicates in the world.

Herdman was a schoolboy at the Edinburgh Academy sixty years ago, and three other boys, sitting in the same small class, all became fellows of this Society, to one of these four, Dr. J. S. Haldane, we are to-day paying the highest compliment in our power! Some five and twenty years before, other four boys were at the Academy together, all fellows of our Society in after years—Tait and Fleeming Jenkin and Lewis Campbell, and Clerk Maxwell, who towers over all. Maxwell paid our Society his first visit when he was twelve years old. At fifteen he wrote his first paper for us, on "The Properties of certain Oval Curves", and when he was sixteen, a student under J. D. Forbes, he wrote another, on "Rolling Curves or Roulettes". But Forbes had to read both of these papers, for it was not thought proper for a boy in a round jacket to address the Society! We have just had the rare luck to discover the MS. of the former paper, in Maxwell's schoolboy hand, together with Forbes's report or epitome, which latter, and not the paper itself, was published, in 1846, in our *Proceedings*.

Let us think of a few more who were men of mark here fifty years ago. As to Lord Kelvin, I can add nothing to what has been so often said, of one who is so well remembered. He was a fellow of the Society for sixty years. His papers on the theory of heat, on hydrodynamical questions, on vortex atoms, on gyrostats, on close-packing of atoms and what not more, adorned our *Transactions* for a long generation. He was the unquestioned leader of the Society, the master of all. He was president until his death, except for the few years when that office was incompatible with his presidency of the Royal Society of London.

Alexander Buchan sat at the table for years as treasurer, a tall and striking figure. He was a humorous man, and showed it by the twinkle in his eye. He said once: 'Everybody thinks me taller than I am; and wiser than I am, and better than I am"—this last having something to do with the fact that he was an elder under Dr. Whyte in Free St. George's! The 'spells' which have made his name a household word have little to do with his real fame. Seventy years ago he had mapped the isobars and isotherms of the world and laid the foundations of all we know of atmospheric circulation. He was probably the very first to show that 'weather travels'; on which cardinal fact all our weather forecasting depends.

Fifty years ago Prof. Turner (not yet Sir William) was one of the secretaries to our ordinary meetings, and in 1908, when Kelvin died, he became by acclamation president of the Society. There is scarcely anyone of whom I have so old a memory, for I remember one day, in the year 1867, an uncle of mine rushing into our house, waving his arms, and crying "Turner's got it"! I told Turner so fifty years after in the Athenæum. He was extraordinarily delighted, he laughed and chuckled, he made me say it all over again. For that had been the great day of his life, when he was elected to Goodsir's chair, after a hard fight with Struthers—to the boundless delight of all the younger men.

Turner lived so long that we can all remember him: his sturdy figure, his rapid walk, his little shake of the head, the twinkle of his eye, his dominant personality. He was a trifle pompous sometimes and fond of the verbiage of the anatomists. He came along when I was doing my first day's work in the old dissecting room. 'Well, what have you got?" said he. "An arm, sir,' said I very timidly. 'Call it a superior extremity, it's so much more precise!' As a demonstrator he was superb. One did not forget one's lesson in a hurry, when Turner had held up nerve or artery in his forceps, and told their names with such a look and voice as though the world depended on them. Of the papers which he read before our Society, many were about whales, for he inherited a lifelong interest in these great beasts from Knox and Goodsir. Turner had none of the poetry, imagination or insight of Goodsir. But there was nothing Turner touched that he did not do with all his might, his love of his subject, his faith and enthusiasm, never flagged for a moment. He was a teacher and a master of men. He fairly won and manifestly deserved the honours that were heaped upon him.

Fifty years and one more year ago, Benjamin Peach was put in charge of the geological survey of the North-West Highlands. Then began a famous chapter in the history of geology, and the unravelling of one of the most difficult regions in the world. It was Peach who first showed the unconformity between the Cambrian rocks and the still older strata; he studied the stupendous thrusts of the great rock masses of the north-west; and he delighted in the old Cambrian fossils of Durness, which his father, coastguardsman at Wick, had been the first to discover. I do not know that Charles Peach, the father, was ever a member of this Society; but I will not let his name, nor his son's name, pass, without paying something of the debt he laid me under. He was a famous naturalist of the old simple school. I and two or three others came under his spell when he was very old and we were boys; and what he taught us, and the love of living things he shared with us, has been worth much to me. What he taught his son was a great deal more. It made him one of the keenest observers, one of the greatest palæontologists and geologists of his time. Both father and son were men of unusual strength and immense vitality; their voices and their laughter come ringing down the years!

Dr Edward Sang, teacher of mathematics, died some forty years ago; he had been a candidate for the natural philosophy chair when Tait won it over Clerk Maxwell. Fifty years ago, an old man Sang was busy constructing his wonderful tables of logarithms, which have never been printed but are among the Society's most prized possessions. They were among the first tables to be independently calculated since Briggs and Vlacq made theirs, immediately after the "Canon Mirificus". All but a hundred years ago, Sang had read a paper to our Society on Nicol's polarising prism—Nicol being an Edinburgh optician who had just invented this indispensable instrument. Sang's paper was never published, no one knows why; and when he was dying he spoke of it to Tait, and said he thought he had never written a better thing. Tait made instant search for the paper, had it read and printed, but poor Sang was dead. Had it been published when it was written it would have been one of the important scientific papers of the time; it contained things which were not said again for nearly fifty years.

John Aitken of Falkirk also lived to a great age, and was a notable figure of our Society fifty years ago. The greatest of all discoverers are those who discover the simplest things, and John Aitken was one of these. 'Why is one's breath visible on a frosty day?' was a question asked, by James Hutton, in one of the first papers ever read before this Society; and Aitken answered it, a hundred years later, in his papers on dust and fog and cloud. How fog and cloud, and all the colours of the sunset, are due to dust particles in the air, dust far smaller than the motes in a sunbeam; how and why the colours of the sunset were intensified fifty years ago, after the eruption of Krakatoa; how and why and when the 'New Moon holds the Old Moon in her arms'—these are some of the things that John Aitken has explained.

George Chrystal came to Edinburgh five and fifty years ago, welcomed with exuberant delight by Tait and others. He was physicist as well as mathematician. He had been one of the first pupils in the Cavendish Laboratory, where Maxwell set him to work on Ohm's law. When he had done, Maxwell said that seldom or never had so searching a test been applied to an empirical law; and he added the curious remark that the way it had stood the test encouraged one to believe that the very simplicity of a physical law might be taken as some indication of its exactness! In later years Chrystal became interested in the oscillations or solitary waves on certain lakes, to which, in Switzerland, Forel had given the name of seiches. Here he found simple experiment and difficult mathematics after his own heart; and the work which he and a certain younger member of this Society did on seiches is as beautiful and as complete an investigation as was ever brought before our Society.

When Chrystal went to Cambridge he found it (as he afterwards said) 'almost decadent as an educational institution"; while in Cayley, Stokes, Adams, Maxwell, it had perhaps the greatest galaxy of talent in all its history! Chrystal became an enthusiast for education, striving to do here what the Cavendish Laboratory was doing and has done in Cambridge; giving mathematics a meaning, direction and purpose, of which the coach and the examiner had not dreamed. I was in our College Library a day or two ago, and two lads were reading diligently near by. I had the curiosity to look at the books they left behind, and both had been reading Chrystal's 'Algebra'. I opened the book at a random page; the chapter was on certain transformations of circular functions; but the interesting thing was to see how Chrystal guided the student, in a few lines, to Riemann on one hand and Cayley on the other; and then to Maxwell and his lines of force and equipotential, and so to an endless variety of physical problems. Between such algebra, a weapon in the hand of the physicist, and the algebra of the old school books, there is all the difference in the world.

With a certain peculiar affection we look back upon Crum Brown. He was one of our secretaries for a quarter of a century and a member of Council for more than forty years. I have already spoken of him sitting quietly at the table, with his little velvet cap upon his head, keenly alive to everything but speaking seldom. Once indeed he brought down the house, with a sort of magic bottle, which squeaked out vowel sounds in a voice not unlike his own, and in so doing demolished a theory of Fleeming Jenkin's to which the Society had listened a few nights before. We students behaved none too well during his lectures, from which we came across the quadrangle to sit quiet as mice under Tait. But we learned afterwards how fine, how erudite, how prescient, how suggestive, how educative Crum Brown's lectures had been.

He was a man of very great originality, he was always before his time When he took his degree, at three-and-twenty, his thesis "On the Theory of Chemical Combination" won no prize, nor was it printed until many years afterwards, but it was a wonderful exposition of structural chemistry, and contained a system of graphic formulæ, undreamed of at the time, but to all intents and purposes that which came ultimately into universal use He began teaching in a little extra-mural laboratory of his own in High School Yards, to the smallest of classes He used to come down to our house of an evening and say (in a voice that some of us can still hear) "As I was saying to my man to day!'—this was his only student The great John Hunter himself had once no more! But when the University chair became vacant on Lyon Playfair's retirement, Crum Brown was known to and recommended by Bunsen, Hofmann, Wöhler, Baeyer, Kolbe, Beilstein—in short, by the greatest chemists of the day

He was a man of insatiable curiosity, interested in what he did not know more than in what he knew He wrote an important paper on the semicircular canals of the ear and their functions and illustrated it by curious experiments and exquisite anatomical preparations He had a passion for making models, geometrical and other There were times when the glue pot was always by his fire, and cardboard always ready to his hand, when he was very old indeed he lay quietly knitting, and the little mats he knitted were recondite models of interlaced figures and interwoven surfaces He had both of these hobbies in common with Maxwell For Maxwell had made some of the same models when he was a schoolboy, and his are in the Cavendish Laboratory to this day, and he once knitted a kettle-holder gayer than the rainbow, for it depicted a square of unannealed glass placed between crossed Nicol's prisms

Crum Brown was at heart a mathematician. He said that unless the young chemist learns "the imperial language of science", the higher branches of chemistry (which require reason as well as skill) will pass out of his hands

I sat in Tait's classroom for the first time well-nigh sixty years ago; and I remember as if it were yesterday the opening lecture which he gave It was on the rainbow and the aurora—and the moral of it was to show how, of two phenomena, one may have been brought within the knowledge and comprehension of mankind, while the other, no less common nor less beautiful, remains a mysterious pageant beyond our ken The days went by and every morning Tait gave us of his best, and all he taught us seemed to be just what we had most wanted to know We also learned the very important lesson (as Prof Flint long afterwards said) that here was a man whose mind was immeasurably greater than our own

Tait played with schoolboy zest when it was playtime, and turned easily from work to play Kelvin said of him that he had made the writing of "T and T' " a perpetual joke, his papers here on "Knots" were one long game—always with the joke behind it that in four dimensions there would be no knots at all! Even in class, once in a way, when he had drawn a freehand circle on the board or skilfully thrown a skipping rope into waves, his eye would meet ours in momentary triumph and schoolboy comradeship But in fact Tait's life was one of arduous and almost continuous labour, play there might be, but idleness never, and with duty nothing was ever suffered to interfere Until the end grew near, when his natural strength abated and sorrow came at the last, he kept the light heart and the happy laughter of a boy, and we who were his pupils, forty, fifty and sixty years ago, still think of him with love, honour and gratitude, and know by a lifetime's experience how rare and exceptional were his qualities of heart and mind

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Muhammad Ibn Umail: an Early Muslim Alchemist

NEARLY twelve years ago, it was mentioned in NATURE of October 28, 1922, p 574 that a well known Latin alchemical treatise entitled "Epistola Solis ad Lunam Crescentem" was apparently a translation of the Arabic work "Risālatu'l-shams ilā al-hilāl (Letter of the Sun to the New Moon) by Muhammad ibn Umail al-Tamimi. This suggestion has been confirmed by Messrs Muhammad Turab Ali, H E Stapleton and M. Hidayat Husain, who, in a lengthy and valuable communication to the *Memoirs of the Asiatic Society of Bengal* (vol 12, No 1, pp 1–213; 1933), have published the Arabic text of (*a*) the Risāla, (*b*) a prose commentary on the Risāla, by the author himself, entitled "Al-mā' al-waraqī wa'l-ard an-najmīyah" (Book of the Silvery Water and Starry Earth), and (*c*) a further poem of Ibn Umail's, entitled "Al-qasidat an-nūnīyah" (Poem rhyming in Nūn) The edition of the texts is the work of Mr M Turab Ali, Messrs Stapleton and Hidayat Husain contribute an excursus on the date, writings and place in alchemical history of Ibn Umail, an edition, with glossary, of an early medieval Latin rendering of the first half of the Mā' al-waraqī, and a descriptive index, chiefly of the alchemical authorities quoted by Ibn Umail

Ibn Umail was formerly believed to have flourished in the second half of the third century A H (that is, A D 864–912), but it is now shown that this date is too early Upon evidence deduced from the period at which his friends, and authors he makes use of, are known to have lived, it appears that his life probably covered the years from 900 to at least 960 A.D, and that his writings are consequently later than those of Razi (Rhazes)

The statement of the bibliographer Ḥājjī Khalifa that his name was not pronounced Amyal (as has sometimes been supposed), but Umail, is confirmed by the vowel points placed on the name in the Leningrad manuscript of the work. It might, however, be mentioned in this connexion that Ḥājjī Abdu'l Muhyī, who possesses a very extensive acquaintance with Arabic alchemical literature, and whom the present writer consulted on the point a few years ago, was emphatically of opinion that the correct pronunciation was Amyal. The Latin transcription Hamuel would support the latter as against Umail; it is therefore difficult to arrive at a final decision.

The importance of Ibn Umail's work lies in its early date, in its possible affiliations with the celebrated "Turba philosophorum", the 'Shawāhid" of Razi, and a treatise by the little known alchemist Mahraris, and in its richly detailed picture of Muslim alchemical thought of the tenth century. Messrs Stapleton and Husain promise us a detailed study of the text of the Mā' al waraqī and its comparison with the work of Razi just mentioned, as soon as leisure from their official duties permits. Meanwhile, an inspection of the Arabic version side by side with the Latin translation shows that while the latter is a creditable production for its age, the translator made a great many slips and not seldom failed completely to understand his author. Those historians who can read Ibn Umail in the original will find an abundant store of important and interesting information in Mr Turab Ali's carefully edited text, but the general reader of alchemical literature must impatiently await an annotated English translation and hope that Mr Stapleton may not long delay it.

The descriptive index of names of people, countries, places and books mentioned in the Mā' al waraqī, with its Latin rendering, and in the Qasīdat an nūnīyah, is largely the work of Prof. Maqbul Ahmad, of Presidency College, Calcutta. It is by no means the least valuable part of the treatise, for it throws considerable light on those personages, real or fictitious, then regarded as authorities, and shows at a glance the books most frequently quoted and therefore presumably esteemed most highly. We note, for example, that Jābir ibn Hayyān is mentioned 31 times, Mary the Jewess 27 times and Hermes no fewer than 51 times. But we feel that we should like to know more of Abu'l Qāsim 'Abdu'l-Mahmūd ibn Ḥayyān, an unsuccessful alchemist and contemporary of Ibn Umail, who worked for twenty three years without letting his furnace go out!

E. J. HOLMYARD

Obituary

PROF. E. W. HOBSON, F.R.S.

ERNEST WILLIAM HOBSON, who was born at Derby on October 27, 1856 and died rather suddenly, after a short illness, on April 19, 1933, had been for many years one of the first of English mathematicians. Although he lived to be seventy six, he was active almost up to his death; his last book (and perhaps in some ways his best) was published when he was seventy four. He was a singular exception to the general rule that good mathematicians do their best work when they are young.

Hobson was the son of William Hobson, who was editor and part proprietor of the *Derbyshire Advertiser*, and was prominent in municipal affairs. He was the eldest of a family of six, J. A. Hobson, the well-known economist, being one of his brothers. His early education was at Derby School, where his mathematical talents were very soon noticed and encouraged. When he was fifteen he obtained a Whitworth Scholarship at what is now the Royal College of Science, and studied physics in London for a short time under Dr. F. G. Guthrie. Two years later he was elected a mathematical scholar of Christ's College, Cambridge. He went into residence in October 1874, 'coached' with Routh, and was Senior Wrangler in 1878.

A S[illegible]r Wrangler of those days succeeded almost [illegible] of right to a fellowship, and Hobson became a fellow of Christ's, and a lecturer in mathematics, in the autumn of the same year. He also did a good deal of private coaching. In 1883 he was made one of the first University lecturers in mathematics. But 'research' meant much less for a college and even for a university lecturer then than it does now, and Hobson wrote very little, and that of little importance, in his early years. His Royal Society memoir on spherical harmonics, which is now classical, and is the first of the papers on which his reputation rests, was not published until 1896.

Hobson's development as an original mathematician seems now to have been strangely slow. By 1903, however, he had moved a very long way; he had (largely as the result of intercourse with W. H. Young) acquired his interest in the modern theory of functions, and he had abandoned coaching in order to win leisure for research. From this time onward he changed rapidly into the Hobson whom we knew. In 1903 he became Stokes lecturer, a position which is now associated definitely with applied mathematics, and has been occupied, since Hobson held it, by Jeans, Fowler and Dirac; but Hobson was by then very plainly a pure mathematician. The first edition of his great "Theory of Functions of a Real Variable" appeared in 1907. In 1910, at the age of fifty-four, he succeeded Forsyth as Sadleirian professor, and he held this office until his retirement in 1931. He was still surprisingly vigorous, but, as well he might be, tured, and he admitted that he found retirement a great relief

Hobson received honours from many quarters He was elected to the Royal Society in 1893, served twice on the Council, and was Royal medallist in 1907 He was president of the London Mathematical Society in 1900–2, and received its de Morgan Medal in 1920 He was president of Section A of the British Association at Sheffield in 1910 He represented Cambridge at the Abel centenary in Oslo in 1902 He was an honorary doctor of six universities, and a member of various foreign academies But he said that no honour paid to him pleased him more than the dinner organised in his honour by the mathematical faculty of Cambridge less than a year before his death

He had many interests outside mathematics As befitted a man of his origin and training, and an intimate and long standing friend of James Ward, he was a keen philosopher Philosophy, indeed, was his strongest external interest, as one could judge from passages of his great book He was not a mathematical logician', but he was attracted by fundamentals, and was the first English mathematician to see the point of the discussions of the 'antinomies' and to recognise the importance of 'Zermelo's Axiom' It was therefore quite appropriate that he should have been one of the two or three mathematicians who have been invited to deliver Gifford lectures In these lectures, which were published as 'The Domain of Natural Science", in 1926, Hobson defends a rather extreme and rather abstract form of the 'descriptive' view of science

Hobson wrote five books in all His Trigonometry" is a well-known textbook which has run through many editions "Squaring the Circle', a reprint of six lectures delivered in 1913, is a popular book which may be compared with Klein's "Vorträge über ausgewahlte Fragen der Elementargeometrie" It is more solid than Klein, but is full of interesting information and most agreeably written, and makes one regret that Hobson did so little in the way of popular exposition The two remaining books, the huge treatise "Theory of Functions of a Real Variable", which occupied him from before 1907 until 1926, and the "Spherical and Ellipsoidal Harmonics", published only in 1931, though a great deal of it was written more than thirty years before, contain the record of most of the chief work of his life

The "Functions of a Real Variable" was published in 1907, at first as a single volume Young's "Theory of Sets of Points" had appeared one year before The modern theories of measure and integration were then almost new, and Hobson and Young were the first to introduce them to English readers. The classical theory of functions of a complex variable had been introduced into Cambridge by Forsyth, but real function theory was practically unknown To-day it is the part of pure mathematics that has been studied most intensively, and it is to Hobson and Young that the revolution is due The book, in its various editions, occupied Hobson for twenty years, and it was no doubt the central fact in Hobson's life, both for himself and for English mathematics The whole theory has expanded out of recognition, and very little of the first edition survives unchanged In particular, nearly all of Hobson's contributions to the subject were made after 1907 and appear only in the later editions The most important of these are to the theory of orthogonal series

It was in 1908 that Hobson published the first of his series of papers on the representation of an arbitrary function by a series of normal orthogonal functions In these papers he aims at obtaining conditions for the validity of such a representation "comparable in generality with the known sufficient conditions for Fourier series" The series in question include Sturm-Liouville series, Legendre series, and Bessel-Fourier series (and also Hermite and Laguerre series, which Hobson does not consider) The theory of integral equations, as developed by Hilbert and Schmidt, had led to a certain unification in the theory of these series, but only for functions of a severely restricted type, Kneser alone had obtained, for Sturm-Liouville series, reasonably general' conditions Here, and in other parts of the theory of orthogonal series, Hobson's work marks a big advance All this is set out systematically in its place in Hobson's book, which is, if any book ever was, a 'standard treatise', and is probably the most important book written by a modern English mathematician

The modern theory of functions of a real variable was in its infancy when Hobson began his work In England it was practically unknown, and rather derided There may perhaps have been a little excuse for the people who, like Greenhill, regarded it as a monstrosity, for there was still a faint air of mystery hanging about the elements and much of the superstructure was inelegant and more than a little tiresome Hobson and Young were the first English mathematicians to see the significance of the new ideas, and fought what must often have been a rather disheartening fight for their recognition Hobson lived to see real function theory the most highly developed mathematical discipline in Cambridge, a subject recognised even as a good Tripos subject', the most popular and paying subject in 'Schedule B The most commonplace Cambridge mathematician now has forgotten the superstition that it is impossible to be 'rigorous' without being dull, and that there is some mysterious terror in exact thought now we go to the opposite extreme and say that "rigour is of secondary importance in analysis because it can be supplied, granted the right idea, by any competent professional" All this we owe very largely to Hobson, but Hobson never quite understood how completely he had won his fight He always retained something of the air of the protagonist of an unpopular cause, he was a little too old to understand fully that everything that he had been fighting for had been achieved.

G H. HARDY.

News and Views

Sir Napier Shaw, F.R.S.

THE Council of the Royal Meteorological Society has made the *Quarterly Journal of the Royal Meteorological Society* of April 1934 a special "Shaw Number", in honour of Sir Napier Shaw's eightieth birthday. Sir Napier Shaw has done a great deal to educate English people to a recognition of the practical importance of meteorology. Under the title 'The March of Meteorology' he has contributed to his own number of the *Journal* a valuable collection of random recollections. This contribution is, besides being much else, an inner history of the evolution of the Meteorological Office during a period of about thirty years which followed his first connexion with official meteorology. One of Sir Napier's greatest personal contributions to meteorology has been connected with the thermodynamical theory built up around the idea of the Carnot cycle—a conception of an ideal heat engine often despised by students of engineering as being of no conceivable practical significance. In his "Manual of Meteorology" the general circulation of the atmosphere receives masterly treatment with the aid of this cycle and of the special diagrammatic framework with temperature and entropy as abscissae and ordinates which he has named the 'tephigram'. Although the full harvest from these ideas is perhaps still to come, they have thrown light on many atmospheric processes previously only very imperfectly understood. Another important contribution, and one that greatly advanced weather forecasting with the aid of synoptic charts, was the 'Life History of Surface Air Currents' (1906). This was the joint work of Sir Napier and his personal assistant R. G. K. Lempfert. This study, in his own words, "began the analysis of the motion of the air of a cyclonic depression into distinct currents which has been so fruitful in the hands of the Norwegian meteorologists". By the writing of these reminiscences at the age of eighty, Sir Napier Shaw shows the staying power characteristic of so many eminent scientific workers who became prominent in a period when the troubles of civilisation were less all pervading, and he reveals in them the broad outlook more common in a less specialised age.

Weather Observations

A SUPPLEMENTARY contribution to the same number of the *Quarterly Journal of the Meteorological Society* by Col. E. Gold follows Sir Napier's with the title "Incidents in the March, 1906–1914". This deals with a number of aspects of the work of the Meteorological Office not touched on by Sir Napier, among which may be mentioned the important contributions to the relationship between barometric pressure gradient and wind force, and to radiation in the atmosphere, made by the writer himself, and to the perhaps even more important pioneer investigations of G. I. Taylor in the subject of atmospheric turbulence, carried out during his tenure of the Schuster readership at Cambridge. It was during those years that the weather observations made at the health resorts were brought under official control, with the result that a reasonable degree of intercomparability has ever since existed in the tabular weather summaries published in most of the morning and evening newspapers, whereas formerly observers had almost unlimited opportunity for creating a false impression of the amount of sunshine to be expected by visitors favouring their own locality. The vexed question of the most suitable units to be used in British meteorology is also touched upon, a question that does not admit of easy solution seeing that the units that satisfy the meteorologist and are intelligible to the ordinary citizen of France and Germany, are not popular with those who through not having been educated in natural science, are unfamiliar with the C.G.S. system and the centigrade thermometer.

Water Supplies and Emergency Legislation

THE letter from Vice-Adm. Sir Percy Douglas, chairman of the British Association Research Committee on Inland Water Survey, which appeared in the *Times* of June 14, is an opportune reminder that something more than merely emergency measures to meet the present water shortage is necessary, if the administration of water supplies in Great Britain is to be placed on a sound and satisfactory basis. There may be in the popular mind a tendency to regard the recent appointment of an expert committee to advise the Ministry of Health on measures for dealing with the effects of the present drought as the sum total of all that is possible or due to be done in order to avert disagreeable and even disastrous consequences at any future time. But, as was pointed out in a leading article on the subject in NATURE of April 28, the root cause of the trouble lies much deeper, and will remain untouched by such superficial and temporary relief expedients as may present themselves for adoption during the existing crisis. In contradistinction to the practice prevailing in leading countries abroad, there is at present in Great Britain no official body charged with the duty of ascertaining available sources of supply and of gauging their extent and capacity, still less of supervising their distribution to the general advantage of the community. The necessity for a thorough investigation of the position in regard to both surface and underground yields is abundantly evident, and it would be foolish to disguise the fact, as Admiral Douglas so strongly emphasises, that "before it is possible to allocate the water supplies of the country an intensive and fully complete survey of the resources available is indispensable, and, however well planned the present emergency measures may be, the need for a systematic national survey remains".

British Science Guild

THE annual report of the Council of Management for the British Science Guild, 1933–34, presented at the annual general meeting on June 12, refers to the activities of the Parliamentary Science Committee, the headquarters of which are at present at the offices of the Guild The Committee is already supported by a number of scientific and technical associations, and active steps are being taken to secure the active interest of the majority of scientific societies The Guild continued during 1933 to make representations to the Government regarding the importance of continuing the work of the Research Association of British Rubber Manufacturers, which the Committee of the Privy Council has now agreed to assist by an annual grant for five years A preliminary memorandum on the development and finance of industrial research has been issued by the committee set up jointly with the Association of Scientific Workers, and arising out of a meeting of the Committee questions have been raised in Parliament regarding expenditure on wireless research by the Post Office and British Broadcasting Corporation The question of adopting the French system of automatic time transmission by telephone has been raised with the Postmaster General and is under consideration Attention has also been directed to the importance of scientific research in connexion with the newly formed marketing boards

LAST year a lecture was instituted by the Guild to direct attention to the importance of research and the utilisation of its results in the service of mankind Largely through the generosity of Lord Melchett and Lord Weir, there has now been instituted a series of such research and development lectures designed especially to bridge the gap that exists between those engaged in national affairs and the man of science Abstracts of the two lectures of this series given this year by Sir William Bragg on Refrigeration" and by Lord Rutherford on "Helium and Other Rare Gases" are appended to the report The report directs attention to the unsatisfactory condition of the Guild's finances There is a deficit of about £400 a year, but thanks to the offer of a member of Council it has been possible to arrange to utilise capital during the next three years while a three year plan is put into operation including a programme similar to that of 1933, every possible assistance to the Parliamentary Science Committee and a sustained effort to increase the annual income

Science and the Nazis

GERMANY'S latest regulation affecting scientific inquiry may be the logical consequence of principles accepted in that country, but is none the less curious Herr Julius Streicher's deputy, according to a correspondent in the *Times* of June 13, has issued an order prohibiting scientific lectures on racial questions, since they have a 'diluting and distorting effect on the Nazi *Weltanschauung*' Professional men of science, it is added, are not equipped with the necessary knowledge and honest conviction and their lectures are, therefore, a danger to the true Nazi creed If this statement has any basis at all in fact, it can only mean that German men of science are either too honest or have too keen a sense of the incongruous to accept and reproduce the official Nazi travesty of racial history with which Herr Hitler has hypnotised himself and the German masses The entire suppression of lectures in one branch of study, however, enforces the lesson that the relation between science and State action is one of extreme delicacy, and that any attempt to drive politics and science in double harness in the interest of a theory of racial or social regeneration, as has been done in Germany, and was attempted in framing the immigration laws of the United States, risks the suppression of honest, but unpopular inquiry It is surely inconsistent that the advocates of racial purity in their own part of the world, in their further programme for dealing with Jews, should suggest that the thirty millions of this people should be quartered among the inhabitants of Madagascar

Central American Hurricane and World Rainfall

WHILE a large area in North America has been suffering from unprecedented drought, a part of Central America has recently experienced a very severe hurricane although it is early in the hurricane season A very small proportion only of the tropical storms of the West Indies and neighbouring mainland occur in the first half of June the time of maximum frequency being not far from the autumnal equinox. The storm in question appears to have passed northwestwards across Salvador before reaching the Mexican coast, it was accompanied by exceptionally heavy rains that caused serious floods To these floods is attributed the great loss of life, variously estimated at a thousand and at two thousand or more In the *Times* of June 13 it is stated that the Honduran town of Ocotepeque, near the Guatemalan border, was entirely destroyed It may be recalled that in 1933 there was a record number of West Indian hurricanes This early and disastrous opening for 1934 seems ominous When rainfall is deficient in middle latitudes there is no more likely place for finding an excess sufficient to keep the world's fall at about its normal amount than in the hurricane belt, and the coincidence of exceptional drought in North America and exceptional storminess in the West Indies may possibly not be fortuitous Approximate constancy of the world's total fall cannot of course, be proved or disproved in the absence of exact measurements over the oceans, but it may be noted that the sun's radiation tends to appear more constant the more exactly it is measured which seems to suggest that the average rainfall for the year—indirectly dependent, doubtless, on solar heat—may not vary greatly

Archæology and the Economic Crisis in the United States

EXCAVATIONS on a number of archæological sites in various States, undertaken as part of the emergency measures for the relief of unemployment under the Civil Works Administration in the United States, have produced material which, according to a statement issued by the Smithsonian Institution of Washington, it will take years to work out in detail So satisfactory have been the results that in several States the work is to be continued by a State subvention now that the grant of the Civil Works

Administration has been exhausted Among the more successful investigations is the exploration of two Indian village sites on the shores of the dry Buena Vista Lake Kern County, California Of these villages one was entirely prehistoric and may go so far back as the beginning of the Christian era. It is hoped to check the dating by the ring marks of wooden posts recovered from the site The second village was occupied by Yokut Indians as late as 1772, when it was visited by Spanish missions; but by 1825 it had entirely disappeared It had evidently been occupied for a long time as no less than seven distinct lake terraces were uncovered in the course of the excavation From a cemetery on the near by hillside 350 skeletons were obtained In the earlier village bodies were buried under the floors of the houses The flint points found here were cruder than those of the later village settlement Among the results obtained under this scheme of exploration in other States mention may be made of a mound near Bradenton in Florida which revealed for the first time the character of a Florida mortuary temple the identification of a village of the Hitchiti Indians of the Creek Confederacy in mounds near Macon Georgia, the identification of Guasili visited by de Soto in North Carolina and the discovery of house structures and much pottery in the Shiloh National Park Tennessee

Excavations at Gaza 1933–34

OWING to the operation of the Antiquities Law of Palestine none of the objects excavated at Gaza during the last season by the British School of Archæology in Egypt has been allowed to leave the country Sir Flinders Petrie accordingly announces that the usual exhibition of antiquities at University College London will not take place this year Lantern lectures on the year's work of the School were delivered at the College on June 14 16 and 19 The main work of the expedition of which a preliminary account was given in a letter from Sir Flinders Petrie in the *Times* of June 14 was directed to clearing an area of about four acres along the river side from which a large number of objects was recovered One of the most noteworthy results was the large number of gold ornaments obtained from burials and from goldsmiths hoards These included ear rings of granular goldwork of unique type The prominence of Irish goldsmiths work is again obvious On the other hand in a burial of a little girl, the gold work is on the Egyptian weights standard and it included pendants of hippopotamus and of Horus The most marked feature of the finds as a whole is their varied provenance pointing to the importance of this ancient port, to which the presence of more than 200 hæmatite weights testified Persian trade is indicated not only by a dagger from Lauristan but also by an abundance of Persian weights in number half as many as those from Egypt Relations with the Caucasus are indicated by daggers of bronze, while the use of the toggle pin, of which specimens were found in all the deposits, belongs to the Caspian The most considerable building unearthed is of middle Hyksos age and may be a temple

Infra-Red Lights and Aviation

HOPES that infra red light might be usefully employed by aviation in foggy weather have, according to Science Service, of Washington, D C, not been fulfilled Dr Irving Langmuir, at a recent meeting of scientific workers and engineers called by the U S Bureau of Aeronautics said that there is no known source of infra-red radiation of the wave lengths necessary for penetrating fog The discovery of a way to produce such radiation would be a stroke of genius and is not likely to occur in the course of routine experimentation The scientific workers present also discouraged experiments by the Government on proposed schemes for the dissipation of fog by the use of a Tesla coil or other apparatus Similar plans have been often suggested and it is now known that it is theoretically impossible for them to work well enough to be of practical value Dr W J Humphreys said that methods based on scientific principles are much too expensive to be used in aviation Two possible solutions of the problem of fog landings were approved by the meeting and intensive research was urged along these lines The first solution was to use radio signals By the use of suitable instruments his position with reference to the flying field can easily be found by the aviator It is now possible to use radio signals the wave lengths of which are not greater than ten metres and this is the possible error of the method It is not necessary to wait until shorter wave lengths are available The other solution favoured was a device similar to that used by ships to determine the depth of the sea beneath them It is quite possible for a suitable instrument to pick up an echo from the ground and show on a dial the height in feet of the plane above it

Refrigeration

IN connexion with the Refrigeration Exhibition now being held at the Science Museum South Kensington a guide has been prepared by Messrs T C Crawhall and B Lentaigne which in addition to describing the exhibits gives accounts of the scientific principles which underlie refrigeration and of its historical development (pp 28 + 2 plates. London H M Stationery Office, 1934 6*d* net) A further publication which will be welcomed by all those engaged in the refrigerating industry is the Five Year Bibliography' of the subject which has been prepared by Mr H T Pledge, of the Science Library (pp 97 London H M Stationery Office, 1934 2*s* net) It is a foolscap pamphlet of 97 pages with the typed entries in two columns under the decimal classification numbers 621 56 to 58, with a short section on air conditioning under 697 9 Under Refrigerants 621 564 there are 8 pages of entries which include between eighty and ninety dealing with dry ice or solid carbonic acid—621 564 22—under its various names of neige carbonique, trockenes ghiaccio secco droog Ijs, glace seche, Cold, Kold Trol, Cardice, Drikold and others The fact that the Science Library has prepared more than 120 bibliographies of this type on subjects varying from

Bessel functions to the habits of lizards seems very little known, and much time has in consequence been wasted by research workers in collecting information on subjects in which bibliographies were already in existence

Street Lighting

ILLUMINATING engineers are beginning to agitate for national control of the lighting of roads and streets In the *Electrical Review* of June 8, C W Sully points out that boroughs and urban councils in Great Britain are granted powers regarding street lighting by the Public Health Act of 1875 and that rural districts exercise their powers under the Lighting and Watching Act of 1833 The public lighting of all our thoroughfares to-day is controlled by Acts published either sixty or a hundred years ago Our population has nearly trebled since 1833 and has increased by more than seventy per cent since the last Act became law There were no fast moving vehicles on our roads sixty years ago—there are now two million licensed automobiles The existence of vast numbers of cinemas and also of greyhound racing tracks encourages pedestrians to use the streets after dark Yet much of our highway lighting is mounted on similar posts spaced at the same distance apart as when our road vehicles were fitted with lanterns carrying candles The candle power of the lights have been increased a hundred fold in order to lessen the risk of accidents but in many roads the lighting is very 'patchy', the lamps acting mainly as beacon lights It is wasteful to employ large units without suitable directive fittings to ensure a uniform distribution of the light The new British Standard Specification makes a special feature of this by setting out a spacing ratio for street lights which produces a more uniform illumination In general this entails altering the height of the posts It would be advisable if the Government would allot to one of its numerous departments the task of specifying the minimum light to be provided on the various roads which it has already classified It appears that new legislation is required to deal with this important matter

Some Aspects of the Vertebrate Brain

In his presidential address before the Linnean Society of New South Wales on March 28, Prof A N Burkitt outlined progress in our knowledge of the structure and workings of the brain The present lopsidedness of our knowledge, so amazing in the physical and chemical world and so backward as regards the very instrument which has created human civilisation, is the cause of much of the discontent and difficulties of our present age. Recent work upon the sense organs and the impulses they transmit to the brain, and some idea of how closely parallel to the physical reality these impulses may be, was discussed, partly in relation to philosophical problems The bearing of the evolution of the sense organs upon the evolution of the brain, so ably outlined by Elliot Smith, was briefly mentioned The importance of the recent discovery that the emotional aspect of life is associated with the activity of a special part of the brain, the thalamus, distinct and separate from the great thinking and discriminatory apparatus, the cerebral cortex, was emphasised, and suggestions were made as to the possible bearing of this knowledge upon the Freudian hypothesis Finally an attempt was made to suggest some inkling of the physiological phenomena that occur in the brain during conscious thinking in all its myriad aspects, also the mechanisms concerned in expression and the control of muscles, together with the evolution of these controlling mechanisms and muscles were briefly outlined

Organisation of Production

UNDER the title Prohibiting Poverty', a pamphlet by P M Martin, written and published by P M Martin Winter Park Florida, outlines a plan for obtaining economic security, based on the view that the prime purpose of organised society is to enable everyone to get a living The plan, described as the National Livelihood Plan, proposes to separate necessaries from luxuries and to deal with them in separate departments of government on different principles The production of necessities is to be organised under a new national organisation known as the Commons, the function of which is to produce and distribute a basic livelihood in necessities to the entire population This organisation would operate without money distributing goods as produced without selling them It would be recruited compulsorily by the whole youth of the nation from school leaving age and would utilise the full advantages of scientific discovery in increasing industrial output and efficiency After eight years service, the Commoner would pass into the Capitals, in which the existing capitalistic organisation of society would persist, limited, however, to the production of luxuries and in which his previous labours have earned him or her a free distribution for life from the Commons of the basic necessities of life The Commons would be directed by a salaried body of technical experts, men of science and investigators concerned with the continual development and full utilisation of improved methods of production

Animal Breeding in the British Empire

THE Imperial Bureau of Animal Genetics has issued a bulletin of 47 pages by Dr F Fraser Darling on animal breeding in the British Empire obtainable from Oliver and Boyd, Edinburgh, or 33 Paternoster Row, E C, at 1*s* It summarises the present position and work in progress in the breeding of farm animals in all parts of the Empire The first part deals with Great Britain and the Dominions, where conditions are mainly temperate, the second part with India and the Colonies, which are largely in the tropics The more practical aspects of the breeding of horses, cattle, sheep, pigs and goats are considered Reference is made to such recent developments as sperm storage for horse insemination, and the fact that breeds of pigs differ in the number of ribs and hence in their value for bacon Useful information is given regarding sheep breeding in Britain, Canada, Australia, New Zealand and South Africa, and the varying problems each country has to face We learn that the world's record for butter-fat production —1,614 lb in a year—is held by an Australian Shorthorn, that Romney Marsh sheep are successful in New Zealand, and that camel breeding is developed by Government in the Sudan Zebu cattle and buffaloes have been introduced from India into the West Indies, Tanganyika and British Guiana Cattle suitable for the tropics can probably be produced by crosses between zebu and certain European breeds Such crosses between zebu cows and Friesian bulls have produced a satisfactory breed in Trinidad, but Krishna Valley zebu in Tanganyika crossed with Devons or Aberdeen Angus give intractable animals unsuitable for domestic uses

National Institute of Agricultural Botany

THE fourteenth report of the National Institute of Agricultural Botany records considerable progress in the selection and multiplication of improved crops Exhaustive tests of yield of many farm and garden plants have been made in different districts and authoritative comparisons of varieties are now available Considerable research is being devoted to problems of seed testing, and a large number of routine tests have been made for other investigators The classical potato trials at Ormskirk, Lancs, seem to have suffered from severe climatic conditions but the work on potato synonyms progresses satisfactorily, and should do much to protect the farmer and gardener from unfair exploitation The head office of the Institute is in Huntingdon Road Cambridge, and a very close co-operation is maintained with related organisations

Ichthyology in the United States

THE twentieth anniversary number of *Copeia* (No 4, December 1933 American Society of Ichthyologists and Herpetologists), which deals with fishes, reptiles and amphibians, is dedicated to its founder, John Treadwell Nicholls In it are included many interesting and valuable papers notable among them being ' Deep Sea Stomiatoid Fishes by William Beebe, in which one new genus and eight new species are described from the Bermuda Oceanographic Expeditions of the Department of Tropical Research of the New York Zoological Society These were all taken within the eight mile circle, the centre of which is at lat 32° 12′ N long 64° 36′ W, 9½ miles south-south west of Nonsuch Island, Bermuda The barbels of some of these fishes are very peculiar; one of them, belonging to *Ultimostomias mirabilis* gen et sp.nov, has a barbel measuring 417 mm in length (more than ten times the length of the fish itself) Other papers on fish are by Albert Eide Parr, George S Myers, E W Gudger and C M Breder, Jr A new snake from Panama is described by E R Dunn and there is an interesting article on the immunity of rattlesnakes to their venom by A A Nichol, Volney Douglas and Lewellyn Peck Other papers are on the nests and young of the Allegheny salamander, the ophidian generic names *Ahaetulla* and *Dendrophis*, secondary sexual characters of *Bufo melanostictus*, and *Pseudemys troostii-elegans* complex a case of sexual dimorphism

Strength of Spirits

As is well known the Finance Act of 1915 provided that where by reason of the high temperature or strength of spirits the ordinary Sikes hydrometer was not applicable, the strength may be ascertained by means of the supplemental Sikes *A* hydrometer using tables identified as II and IV prepared by the late Sir Edward Thorpe when principal of the Government Laboratory Under the Strength and Weight of Spirits Ascertainment Regulations 1930 when the same conditions of high temperature or strength apply, the use of a further supplemental Sikes *B* hydrometer is permitted When this is used without the poise marked *A* attached, Tables V and VI prepared by Sir Robert Robertson are applicable Tables II, IV, V and VI have been issued under the authority of the Commissioners of H.M Customs and Excise in one volume at 2*s* 6*d* (London H M Stationery Office) the ordinary tables I and III are printed in a separate volume The tables cover temperatures from 30° to 100° F

Institution of Petroleum Geologists

THE summer meeting of the Institution of Petroleum Technologists will be held in London at the Royal Society of Arts on June 28–29 The programme consists of a series of papers, available in advance, on general topics which will be submitted for discussion The subjects of the first day's discussions are the relation of oil and coal to the petroleum industry measurement of oil in bulk, and the format of the Institution's *Journal* The second day is being given to a series of reports on the progress of naphthology, the Refining and Chemical Section under the chairmanship of Dr F H Garner, will occupy the morning session, while the Field Technology Geology and General Sections, under the chairmanship of Mr A Beeby Thompson, will take up the afternoon session During the course of the annual dinner on June 29 the Redwood Medal of the Institution will be presented to Dr David White, of the U S Geological Survey, who is known for his studies in palæobotany This medal is awarded biennially, and is given for contributions to our knowledge of petroleum technology

Rockefeller Medical Fellowships

THE Medical Research Council announces that, on behalf of the Rockefeller Foundation of New York, it has made the following awards of travelling fellowships for the academic year 1934–35: Mr I Aird, demonstrator in anatomy, University of Edinburgh, and clinical tutor in surgery, Royal Infirmary, Edinburgh, Mr I A Anderson, house physician, Royal Infirmary, Aberdeen; Prof E G Oastler, professor of physiology, St Mungo's College, Glasgow, and assistant physician, Royal Infirmary, Glasgow, Mr W H Owles, resident medical registrar, Queen's Hospital, Birmingham; Dr H L Sheehan, lecturer in pathology, University of Manchester, Mr C Wilson, assistant in pathology, London Hospital These fellowships are awarded to graduates who have had some training in research work either in the primary sciences of medicine or in clinical medicine or surgery, and who are likely to profit by a period of work abroad before taking up positions for higher teaching or research in the British Isles All the fellows appointed this year will work at centres in the United States

International Council of Scientific Unions

THE International Council of Scientific Unions will hold its triennial meeting at Brussels on July 9–14 At the last meeting, in 1931, the title of the organisation was changed from that of the International Research Council to the present one and the statutes were revised to give greater freedom of action to the international unions On the present occasion each of these unions, representing astronomy geodesy and geophysics, chemistry, scientific radio transmission, physics, geography and biological science will communicate an account of its activities during the past three year period Addresses will also be given by Dr D la Cour on the International Polar Year 1932–33, its aims, methods and some preliminary results, by General G Perrier, on recent international determinations of longitude, by Dr E P Hubble, on the exploration of space and by Prof H R Kruyt on electricity and hydration of colloids

Announcements

A MOSELEY Research Studentship of the Royal Society has been awarded to Dr Barnet Woolf for research on bacteriology and immunology

SIR HAROLD HARTLEY, chairman of the Fuel Research Board of the Department of Scientific and Industrial Research, is inviting a number of scientific workers and industrialists to inspect the work in progress at the Fuel Research Station, River Way Blackwall Lane, East Greenwich, S E 10, on June 25 The function will be generally similar to the annual visitation of the National Physical Laboratory, but it is the first of its kind to be held at the Fuel Research Station.

A SCIENTIFIC committee to assist the director, Dr Louis Martin, has been formed at the Institut Pasteur, Paris, consisting of MM J Bordet, director of the Institut Pasteur of Brussels, and Nobel prizeman; G Bertrand and F E P Mesnil, members of the Institut de France and Académie de Médecine, C J H Nicolle, professor at the Collège de France and Nobel prizeman, A J E Yersin, director of the Instituts Pasteur of Indo-China, and A Borel, director of the Institut d'Hygiène at Strasbourg Further members may be appointed later

AT the seventeenth annual meeting of the American Society of Ichthyologists and Herpetologists, held in New York on May 10–12, the following were elected officers for the ensuing year: *Honorary Presidents*, Leonhard Stejneger and John T Nichols; *President*, Carl L Hubbs, *Vice Presidents*, Dr E W Gudger, Dr Francis Harper and Clifford Pope; *Secretary* M Graham Netting; *Treasurer*, A. W Henn, *Editors*, Carl L Hubbs and Helen T Gaige The next meeting of the Society will be held in Pittsburgh in May 1935

MESSRS A GALLENKAMP AND CO, LTD (17–29 Sun Street, and 1–3 Clifton Street, London, E C 2) announce the introduction of a new type of all glass syringe for medical use It is constructed of pyrex glass in various sizes, and is provided with stainless steel needles Copper coated glassware—beakers, flasks etc —is also supplied by this firm The copper is electrolytically deposited on the outside and the advantages claimed are rapid distribution of heat and saving of the liquid should the glass crack

APPLICATIONS are invited for the following appointments on or before the dates mentioned —A lecturer in mathematics and physics at the Portsmouth Municipal College—The Registrar (June 25) Part time lecturers and instructors in engineering welding, electrical installation etc at the Willesden Technical College Denzil Road London N W 10—The Principal (June 25) A professor of botany in the Egyptian University—The Dean of the Faculty of Science, c/o The Director, Egyptian Education Office 39, Victoria Street, London, S W 1 (June 25) A head of the Women's Department in the Wolverhampton and Staffordshire Technical College—The Clerk to the Governors Education Offices, Wolverhampton (June 25) A lecturer in botany and a lecturer in zoology at Armstrong College, Newcastle upon Tyne —The Registrar (June 26) A teacher of chemistry at the Doncaster Technical College—The Secretary, Education Offices Doncaster (June 27) An assistant civil engineer to the Air Ministry—The Secretary (S 2) Adastral House, Kingsway, W C 2 (June 28) A metallurgist to the British Non Ferrous Metals Research Association—The Secretary, Regnart Buildings, Euston Street London, N W 1 (June 30) A lecturer in science at the Gordon Memorial College, Khartoum—The Secretary (Sir/C A), Board of Education, Whitehall, London, S W 1 (June 30) An assistant lecturer in electrical engineering at University College, Nottingham—The Registrar (July 2) A research assistant in soil science in the Department of Agriculture, University of Cambridge—The Secretary of the School of Agriculture (July 2) A field officer for investigations on Braxy like diseases of sheep and a junior research officer for investigations on swine erysipelas at the Institute of Animal Pathology, University of Cambridge—The Director (July 7) A professor of social anthropology in the University of Cape Town—The High Commissioner for the Union of South Africa, Trafalgar Square, London (Aug 15) A Regius professor of midwifery in the University of Glasgow—The Private Secretary, Scottish Office, Whitehall, London, S W 1 A chemist at the East Malling Research Station, Kent—The Secretary

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Early History of Mendeléeff's Periodic Law

THE statement appears in NATURE of April 28, p 656, that Mendeléeff's first table, published in 1871 bears a remarkable resemblance to that of the present day As a matter of fact, Dmitri Ivanovitch Mendeléeff began his investigations on the correlation of chemical properties with the atomic weight of elements in 1868, and succeeded in evolving the periodicity of this relationship at the end of that year He printed the first periodic table in the middle of February, 1869 as follows

An attempt of a system of elements
based on their atomic weight and chemical resemblance

			Ti = 50	Zr = 90	? = 180
			V = 51	Nb = 94	Ta = 182
			Cr = 52	Mo = 96	W 186
			Mn = 55	Rh = 104 4	Pt = 197 4
			Fe = 56	Ru = 104 4	Ir = 198
			Ni = Co = 59	Pd = 106 6	Os = 199
H = 1			Cu = 63 4	Ag = 108	Hg = 200
	Be = 9 4	Mg = 24	Zn = 65 2	Cd = 112	
	B = 11	Al = 27 4	? = 68	Ur = 116	Au = 197?
	C = 12	Si = 28	? = 70	Sn = 118	
	N = 14	P = 31	As = 75	Sb = 122	Bi = 210?
	O = 16	S = 32	Se = 79 4	Te = 128?	
	F = 19	Cl = 35 5	Br = 80	J = 127	
Li = 7	Na = 23	K = 39	Rb = 85 4	Cs = 133	Tl = 204
		Ca = 40	Sr = 87 6	Ba = 137	Pb = 207
		? = 45	Ce = 92		
		?Er = 56	La = 94		
		?Yt = 60	Di = 95		
		In = 75 6	Th = 118?		

Mendeléeff prepared his first essay, 'Correlation of the Properties with the Atomic Weight of Elements', early in March, 1869 intending to communicate it to the Russian Chemical Society (which was founded on October 26 1868) at the meeting on March 6 Illness prevented him from attending and the paper was read at his request, by my father, Nikolai Aleksandrovič Menschutkin at the time professor of analytical chemistry at the University of St Petersburg Mendeléeff's memoir was printed in the first volume of the *Journal of the Russian Chemical Society* (1869, pages 60–77) it contains the same table as that printed above, the enunciation of the periodic law and the deductions (*a*) that the atomic weights of some elements must be altered, to fit into the table, (*b*) that undiscovered elements exist, filling up the vacant places of the table

Continuing his work on that subject, D I Mendeléeff communicated further results on August 23, 1869, in a meeting of the Second Congress of Russian Naturalists in Moscow This communication was published in the Transactions of the Congress (pages 62–71) under the title 'On the Atomic Volume of Simple Bodies" Mendeléeff recognised the importance of this periodically changing property of elements for their classification, and gave the following table— the prototype of all later periodic tables

Li	Be	B	C	N	O	F			
Na	Mg	Al	Si	P	S	Cl			
K	Ca	—	Ti	V	Cr	Mn	Fe	Co	Ni
Cu	Zn	—	—	As	Se	Br			
Rb	Sr	—	Zr	Nb	Mo	—	Rh	Ru	Pd
Ag	Cd	—	Sn	Sb	Te	I			
Cs	Ba	—	—	Ta	W	—	Pt	Ir	Os

In the text, this table is completed by the heavy metals Au, Hg, Tl, Pb, Bi Elements, the atomic weights of which were not known with any degree of certainty, such as In, Th, U, Ce, are left out

I do not propose further to follow up Mendeléeff's work here, only mentioning his communication at the meeting of the Russian Chemical Society of December 3, 1870, in which he divided the elements into the periods, rows and groups, now familiar to all students of chemistry He also made here detailed predictions of the properties of undiscovered elements, which were verified in the years 1875–86 through the discovery of gallium scandium and germanium

Thus Mendeléeff s periodic table actually antedates his periodic law and received its modern form in 1869 not in 1871

B N MENSCHUTKIN

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May 13

Mesomerism and Tautomerism

THE recognition of valency exchange degeneracy as a matter of primary importance in relation to the energy[1] and reactivity[2] of organic molecules makes it the more necessary clearly to indicate the nature of the conception It envisages both completely and incompletely degenerate states collectively called 'mesomeric' states, and these states are described by first setting up unperturbed structures', which correspond to classical chemical formulæ but (according to the theory) not exactly to reality and then 'correcting' these structures by supposing them to undergo a perturbation', the nature of which may be indicated by auxiliary symbols

The idea appears to have gained some ground that the conception of the mesomeric state is unnecessary, that the unperturbed structures are all that exist, and that these pass into each other like tautomerides but much more rapidly, the great frequency of interchange accounting for the energy effect If this view has arisen from the use of the expression resonance, a long accepted synonym for exchange degeneracy, then it must be admitted that an analogy has been suggested which was never intended (the real analogy underlying this term is a mathematical one)

It is a characteristic of tautomeric systems that forms exist which clearly correspond to separate molecular states, because each molecule spends the whole of its life partly in one form and partly in the other, and only a proportionately quite insignificant time in the actual process of transition If, however, in any of the most typical cases of 'resonance', we attempt to interpret resonance energy as a tautomerism of unperturbed states, the frequency of interchange which it is necessary to assume in order to account for the energy effect is often so great as to require that the molecules must occupy their time in changing, and cannot remain quiescent for significant periods in either of the assumed states, in other words, the term 'state' loses its meaning in reference to the only states which this theory recognises The assumed frequency of valency interchange is, indeed, of the same sort of magnitude as the frequencies which are attributable generally to combined electrons, aside altogether from valency resonance. There can be no physical distinction, therefore, between resonance vibrations and other electronic vibrations, and it follows that the unperturbed structures, in which the resonance vibrations are absent by assumption, are unreal they are of the nature of intellectual scaffolding, and only the mesomeric state is real The additional electronic energy associated with resonance naturally implies an altered wave function but the reasons why we do not associate this energy difference with a definite frequency along a definite path are quite analogous to the reasons for not reverting to Bohr orbits in the description of molecular structures generally[3]

The energy evidence proves this point[1] and the results of infra red spectroscopy and dipole moment measurements supply important confirmation[4] it may, however, be worth noting that the thesis is necessary also on quite elementary chemical grounds[2] For this purpose any simple problem of reactivity in which mesomerism plays a leading part will serve and we may, for example consider the fact that aniline is a weaker base by about a million fold than a primary alkylamine such as methylamine or *tert* butylamine The neutral unperturbed structure for aniline, $NH_2{-}C_6H_5$ requires a basicity of about the same order of magnitude as that of a primary alkylamine, and the three dipolar unperturbed structures which may collectively be represented $\overset{+}{N}H_2{=}\overset{-}{C}_6H_5$, all require a basicity (for ammonium salt formation) of zero If we were to try to account for the small basicity of aniline by postulating a tautomerism too rapid for direct detection, between these unperturbed structures considered as molecular states, we should have to assume that the substance exists practically entirely in the betaine forms—an obviously untenable hypothesis The only way to avoid this difficulty would be to increase the assumed rate of interchange to such a degree that the molecules would almost always fail to remain in the more basic form, $NH_2{-}C_6H_5$ for the duration of a molecular collision, for if this were true even a high instantaneous concentration of NH_2 C_6H_5 molecules would fail to produce a corresponding amount of basic reactivity A supposition of this kind however is tantamount to discarding altogether the conception of unperturbed forms as molecular states and adopting in its place the idea of a state distinct in properties from either of the states originally assumed

Thus mesomerism and tautomerism are different concepts and we must ascribe to the mesomeric state something more than a titular position in the physics and chemistry of unsaturated structures[5]

C K INGOLD

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May 24

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[1] L Pauling and G W Wheland, *J Chem Phys* 1, 362 1933 L Pauling and J Sherman, *ibid*, 606 679

[2] C K Ingold *J Chem Soc* 1120, 1933

[3] Cf J E Lennard Jones, forthcoming report by Faraday Society

[4] References given in [1] Cf also N V Sidgwick and L E Sutton forthcoming report by Faraday Society

[5] I myself wrote (before 1926) of valency tautomerism but I now regard that expression as an unfortunate contradiction in terms (Cf ref [2] p 1127 footnote 4)

Kinetics of Reactions of Heavy Hydrogen

THE publication, recently, of two notes[1] concerning the reaction of heavy hydrogen and oxygen at elevated temperatures suggests that it may be of interest to mention briefly experiments which have been in progress in this laboratory during the past few months and which have had for their object the possible confirmation or elucidation of the mechanism of some chain reactions A search has also been made for examples of reactions involving the quantum mechanical leakage of H and of D atoms through potential barriers

At room temperatures and with excess hydrogen H and D atoms produced photochemically react with oxygen molecules at exactly the same speed With excess oxygen under the same conditions, there is a difference (30 per cent for a 66 per cent mixture) which is due solely to collision frequency factors between the mercury atoms and the H_2, HD, D_2 and O_2 molecules Similarly in the hydrogenation of ethylene and of nitrous oxide and in the reduction of copper oxide by atoms there is no difference in the velocity of reaction of the two isotopes

At higher temperatures in the hydrogen – oxygen reaction where chains are propagated separation occurs for example at 339° C With a pressure of 5 mm of a 2 1 mixture the ratio of rates of reaction for a 66 per cent diplogen mixture is 1 26 1 falling to 1 10 1 at 421° The difference is probably due to the participation of hydrogen molecules in the chain In the hydrogen – nitrous oxide reaction where chains are also propagated and the slowest now involves the reaction of a hydrogen atom there is no separation whatsoever With ethylene there is no separation and no chain propagation Copper oxide is reduced at different speeds with heavy and with ordinary hydrogen molecules the separation decreasing with increasing temperature, for example, the ratio of rates for a 47 per cent mixture are at 156° 1 26 at 201° 1 17 and at 269° 1 13

So far as these results indicate therefore the statement may be made that H and D atoms, even in reactions requiring considerable activation react at the same speeds in the gas phase whereas, if the rate determining step involves a molecule or the interaction of the atom adsorbed on a surface, as in the reduction of copper oxide the greater reactivity of hydrogen is due mainly if not wholly to the difference in zero point energies of the H and the D molecules

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Cambridge

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[1] Frost and Alyea *J Amer Chem Soc* 56, 1251, 1934 Hinshelwood Williamson and Wolfenden NATURE 133 836 June 2 1934

Ionospheric Height Measurement in the United Provinces of Agra and Oudh (India)

THE measurements of the height of the ionosphere have been taken in India for the last three years by Prof S K Mitra[1] and his students in Calcutta India is such a big country that the measurement at Calcutta alone cannot serve as representative values for the whole of India Early this year therefore it was decided to take measurements at Allahabad, and the preliminary observations are summarised below

The transmitter employed was of the conventional type sending 50 pulses per second of $3\ 8 \times 10^{-4}$ seconds duration Through the ready co-operation of Rai Amarnath Agarwal—to whom our thanks are due—the receiving equipment was located at his residence in Daraganj, a distance of about 2 miles from the transmitter The echoes were visually observed on a cathode ray oscillograph

On May 13 between 18 30 and 20 00 I S T, the height of the *E* layer was found to be 135 km and usually four multiple reflections and sometimes as many as six were detected Between 19 00 and 19 30 I S T the intensity of the first reflection often shot up to 2 3 times that of the ground wave but this unusual intensity lasted for about 3–5 seconds Between 19 15 and 19 20 the intensity of the second reflection was found on two occasions to be from 3 to 4 times that of the ground pulse although the intensity of the first reflection was only about half that of the ground pulse

Further observations were taken in the early morning hours (5 30–6 30) of May 14 The height of the *F* layer was found to be 270 km in the beginning and gradually fell to 250 km Four reflections were usually present the first was always the strongest its intensity sometimes becoming as great as that of the ground pulse

The distance between the adjacent reflections was always the same thus showing the presence of multiple reflections between the earth and the ionosphere Messrs Mitra and Rakshit[2] could detect the multiple reflections one hour before the sunset but we have been able to observe multiple reflections in the morning as well

It appears from our observations that the *E* layer is predominant during the evening and sunset period and during the night the ionisation in the lower layer becomes too small and up to about half an hour after sunrise reflections from the *F* layer are observed

The work is being continued

G R Toshniwal
B D Pant

Physical Laboratory
Allahabad
May 21

Mitra and Rakshit *Phil Mag* 15 20 1933

[2] *loc cit* p 26

Effect of Thunderstorms upon the Ionosphere

Morgantown West Virginia U S A is situated on the western slope of the Appalachian Mountains which run in a south westerly direction These mountains cause a great deal of variation in the signal strength of the broadcasting stations along the Atlantic coast as received in Morgantown and also affect the short wave band

One of my students Mr A W Friend has been operating a short wave station here for many years He informs me that on account of the high hills near his home his station cannot be heard in the south eastern sector of the United States *except after a thunderstorm* He can hear the amateur short wave stations in the southern States but they can never hear him if the weather is fine but after a thunder storm he can remain in contact with them for several hours

At my suggestion Mr Friend made out the following table from the log of his station It shows the times at which the stations were able to hear him

Station	Date	Time	Freq Kc.	Output, watts
Greensboro N C	April 29 1931	11 16 p m	7 000	12
Wilmington N C	April 30 1931	6 15 p m.	7 000	12
Marion Ala	June 2, 1931	12 55 a.m.	7 000	12
Atlanta, Ga	June 5 1931	10 38 p m.	14 000	8
Salisbury N C	Aug. 24 1931	1 05 a m.	7 000	15

These stations are all located several hundred miles south or south east of Morgantown and two way communication was never possible under normal atmospheric conditions Mr Friend's observations strongly support Prof C T R Wilson s theory that some of the ionisation in the ionosphere is due to thunderstorms Not all of the abnormal ionisation arises from local thunderstorms for I have often observed increased ionisation in the *E* layer after sunset during the winter months when there were no thunderstorms within a thousand miles

R C Colwell

Department of Physics
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May 18

Static Charge on a Galvo-Millivoltmeter

In Nature of May 19 Mr H A Bromley mentioned the trouble he had experienced owing to the needle of a millivoltmeter being attracted by the electrostatic charge on the surface of the glass window of the instrument

This trouble has been known for many years and is usually overcome by wiping the glass with a cloth on which there is a slight trace of glycerine This so effectually gets rid of the trouble for a little while —when the process has to be repeated—that I think readers of Nature may be glad to know of it

Robert S Whipple

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45 Grosvenor Place London S W 1

Velocity of Light

The chief objection which can be raised at the present time to the hypothesis of a continuous decrease of the velocity of light is that it is only justified if we admit that the work of Michelson and Newcomb in the last century is unreliable Now their determinations made in 1882 agree so closely although made independently with different instruments and a somewhat different technique that, in my opinion they are probably very accurate

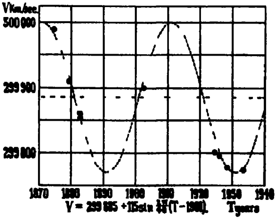

Fig 1

Seven years ago I pointed out that the problem would be simplified if it were admitted that the velocity fluctuates[1] The arbitrary rejection of some observations would not then be required there having been a decrease in 1874–1883 and another in 1902–1934 An irregular variation, however is of little scientific value it is so easy to fit one to the observations a regular periodic variation on the other hand, if it fits all the observed values without omitting any, would be much more convincing than a linear law which ignores one third of the data The remarkably close agreement of Edmondson's sine law of variation[2] with the observations cannot be fully appreciated without a graphical representation such as that reproduced as Fig 1, it is significant, particularly because of its simplicity and because the period is the longest possible a sinusoid which would 'pick up' Perrotin s value artificially by a multiplicity of undulations due to a short period would carry no conviction whatever to my mind, but the manner in which the graph 'picks up' (in passing, so to speak) this isolated value of 1902 is most remarkable and, in my opinion, convincing Such a nine fold coincidence cannot be fortuitous

M E J GHEURY DE BRAY

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May 24

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[1] *Astr Nachr* No 5520 1927 *L Astronomie* November 1927
[2] NATURE 133 759 May 19 1934

Abnormal Permeability Produced in a Steel Wire by Loading

USING the ballistic method previously described[1], recent investigations have shown that an abnormally high value for the permeability of a steel wire can be obtained by loading

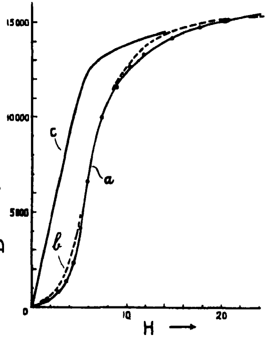

FIG 1

In Fig 1, the curve *a* shows the relationship of *B* and *H* obtained by the ordinary method of reversals for a mild steel wire of 0 092 in diameter, the wire being unloaded Curve *b* shows the values of *B* and *H*, also obtained by the method of reversals, when the wire was supporting a steady load of 202 lb (that is, a stress of 13 7 tons per sq inch)

By means of the ballistic test described[1], the increase of induction density ΔB was obtained as a function of *H* when a load of 202 lb was gently applied Before each application of the load, the magnetic intensity was raised to a value of about 200 gauss and the desired value of *H* was then reached by reversing the exciting current of the solenoid many times The curve *c* in Fig 1 has been obtained by adding the value ΔB to the corresponding value of *B* given by the curve *a* It is seen that for low values of *H*, the permeability given by curve *c* is more than ten times the normal value of the permeability as given by the curve *a*

Loading the wire when it is placed in a steady magnetic field of suitable intensity gives rise to a very marked increase of permeability

By means of a somewhat different procedure, Ewing[2] obtained very large increases of induction when an iron wire, which had previously been stretched beyond its elastic limit, was loaded For annealed iron wire, however, the effect was very much less So far as I am aware the results now given are the first yet recorded showing the immense increase of induction produced by loading an unfatigued steel wire

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May 10

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[1] NATURE 132 513 Sept 30 1933
[2] *Phil Trans* 1885

A Haploid Plant of *Nicotiana sylvestris*

ATTEMPTS to produce a merogonic fully developed animal organism have been unsuccessful plants appear to be more convenient subjects for this purpose We know two androgenic haploids at the present time and both belong to the genus *Nicotiana* One was produced by pollinating a triploid *Nicotiana Tabacum* plant (2*n* 72) with *N Langsdorffii* (2*n* 18) From such a cross a *Nicotiana Langsdorffii* androgenic haploid with 9 somatic chromosomes was produced[1] The other androgenic haploid was produced by pollinating the amphidiploid *N glutinosa* × *N Tabacum* *N digluta* with *N Tabacum* (2*n* 48) From such a cross an androgenic *N Tabacum* with 24 somatic chromosomes has been produced[2]

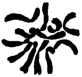

FIG 1 Somatic metaphase from a root tip of the haploid *Nicotiana sylvestris*

Recently we produced another *Nicotiana* haploid by pollinating the F_1 hybrid *N Tabacum* × *N sylvestris* with pollen from *N sylvestris* (2*n* – 24) Considering the former two cases, it seems very probable that the haploid thus produced has developed from a sperm nucleus The haploid is a dwarf *Nicotiana sylvestris* plant with smaller cells than the normal (diploid) *N sylvestris* The haploid has two chromosomes with small heads, two with large heads (subterminal constriction), four with medial constrictions and four with submedial constrictions (Fig 1) In the root tips of the haploid plant single cells or even whole sectors were found with diploid chromosomal constitution—a condition which often occurs in haploids

It is most probable that this haploid has developed from a *sylvestris* sperm nucleus, but it is also possible although not very probable that it has origin ated parthenogenetically from an egg cell having only *sylvestris* chromosomes Such an egg cell can be produced if all the *sylvestris* chromosomes (12) separate and move toward one pole while the *Tabacum* chromosomes (24) move toward the other pole during the reduction division in the F_1 hybrid The chance for such a chromosomal distribution during the reduction division is very small When we consider the fact that parthenogenesis is a rare occurrence—only one egg cell (haploid) may develop parthenogenetically out of several thousands—it seems very improbable that our *sylvestris* haploid has such an origin

Detailed morphological description of the haploid and its cytogenetical behaviour will be given elsewhere

DONTCHO KOSTOFF

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Leningrad

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[1] Kostoff, Dontcho An Androgenic *Nicotiana* Haploid *Z Zellforsch* 9 640 1929

[2] Clausen R E and Lammerts, W E, Interspecific Hybridisation in *Nicotiana* (10) Haploid and Diploid Merogony *Amer Nat* 63, 279 1929

Influence of Thyroid Preparations on the Plumage of Birds

IN an earlier communication[1] we described experiments on the supposed influence of the thyroid hormone on the moulting mechanism of feathers in aquatic birds which manifested very striking resistance to thyroid feeding and to the injection of thallium acetate After controlling the thyroid preparations which produced the shedding of feathers in hens and caused metamorphosis in tadpoles the thyroid glands of ducks and geese have been examined The great difference observed between them and the thyroid gland of the chicken was found to be due chiefly to different anatomical structure and to tremendous development of the corpuscula epibranchialia (corpuscula epithelialia or parathyreoidea of other authors) in ducks and geese

It seemed to us therefore that the corpuscula epibranchialia may have a neutralising effect on the influence of thyroid in our experimental aquatic birds It is also possible to presume such a neutralising influence in the testis hormone of drakes as suggested in the interesting publication of Mr R George Jaap of the University of Wisconsin in Poultry Science referring to testis enlargement and thyroid administration in ducks although we used in our experiment both male and female ducks

Bearing in mind this possibility we repeated the experiment now with a uniform batch (in regard to origin age and so on) of hens divided into four groups treated as follows (1) fed with thyroid preparations, (2) fed with thyroid preparations and given injections of extract (in Ringer s solution) of corpuscula epibranchialia of geese and ducks (3) fed with thyroid preparations and given injections of testis hormone prepared from drakes testes and (4) a control group given injections of Ringer s solution only and including other hens without special treatment

The result was again very striking While hens of the first and third groups began on the 8–9th day to lose their feathers and on the 12th day there were all the symptoms of severe moulting, the group injected with the extract of corpuscula epibranchialia as well as the control animals remained quite resistant to thyroid feeding

This experiment was repeated twice with the same result and at the same time histological examination was made of the corpuscula epibranchialia Some interesting results were observed, for example tadpoles given a very small dose of the extract of corpuscula taken from geese died on the second third day but the control tadpole fed on goose s thyroid gland and other thyroid preparations continued alive and active

A detailed report of these experiments is in preparation

R PRAWOCHEŃSKI
B SLIZYNSKI

Zootechnical Laboratory
Jagellonian University
Cracow Poland
May 20

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[1] NATURE 132 482 Sept 23 1933

Energy Spectrum of Positive Electrons ejected by Radioactive Nitrogen

THE velocities of positive electrons emitted by boron when bombarded by α particles of radium C with a range reduced to 6 3 cm were investigated by the magnetic focusing method, the electrons being detected by coincidences in two contiguous Geiger Muller counters[1] The measurements could only be extended up to the value of $H\rho$ 7800 The energy distribution obtained is shown in Fig 1 For each point of the curve 100–200 positive electrons were counted The natural background was 20 per cent of the measured value

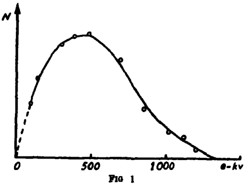

FIG 1

The shape of the curve is similar to that for the β spectrum of radium E The limit of the spectrum corresponds to about 1 3 × 10^6 ev A similar energy distribution was found by Anderson and Neddermeyer in the case of carbon bombarded by diplons[2] Thus the half period[3] and the energy spectrum of positive electrons of radioactive nitrogen do not depend on the method of its production

The most probable way of producing N^{13} in our experiments may be assumed to be

$$ {}_5B^{10} + {}_2He^4 \rightarrow {}_7N^{13} + {}_0n^1 $$

while in the case of Crane and Lauritsen, measured by Neddermeyer and Anderson the supposed reaction was

$$ {}_6C^{12} + {}_1D^2 \rightarrow {}_7N^{13} + {}_0n^1 $$

Thus, starting both from ${}_5B^{10}$ and from ${}_6C^{12}$ one gets the same kind of radioactive nitrogen ${}_7N^{13}$ with the same characteristic constants

The energy distribution in the case of aluminium and magnesium is similar to that of the β spectrum of thorium C + C″ the limit lying above 2 × 10⁶ ev

A J ALICHANOW
A J ALICHANIAN
B S DZELEPOW

Physical Technical Institute,
Leningrad
May 13

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[1] Alichanow NATURE 133 581, April 14 1934
[2] Anderson and Neddermeyer Phys Rev, 45 498 1934
[3] I Curie and F Joliot NATURE 133 201 Feb 10 1934 Ellis and Henderson NATURE 133 530 April 7 1934 Crane and Lauritsen Phys Rev 45 430 1934

Absorption Spectrum of Diatomic Arsenic

A NEW system of some eighty absorption bands has been discovered in the spectrum of arsenic between 2200 A and 2750 A which can be definitely assigned to the diatomic molecule This includes the five faint fluorescence bands observed by Rosen[1] and tentatively ascribed to As_2 The whole system bears a striking resemblance to that of P_2 investigated by Herzberg[2] where $\Delta G''$ is about 750 cm^{-1} and $\Delta G'$ 470 cm^{-1} A preliminary analysis gives for arsenic ΔG values that are about 420 cm^{-1} for the lower and 270 cm^{-1} for the upper state The vibrational levels of both states converge very slowly

The emission spectrum of phosphorus is attributed by Herzberg to a ${}^1\Sigma_g^+ \leftarrow {}^1\Sigma_u^+$ transition in which the upper potential curve is crossed by another possessing a flat minimum and a lower heat of dissociation which is either a ${}^3\Sigma_u^+$ or a ${}^3\Pi_u$ state This causes predissociation in the upper and perturbation of the lower vibrational levels of the ${}^1\Sigma_u^+$ state The graph of the ΔG values of our arsenic bands shows a discontinuity at $v = 4$ which appears to represent perturbation similar to that observed by Herzberg

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[1] Rosen Z Phys 43 69 1927
[2] Herzberg NATURE 126 239 Aug 16 1930 Ann Phys (5) 15 677 1932

Bands of 'Heavy' Acetylene in the Near Infra-Red

THE infra red spectrum of acetylene prepared from calcium carbide and 93 per cent heavy water has been examined photographically up to 12 000 A with a 4 m absorbing length at 2 atmospheres[1] Four bands have been observed, all of which belong to C_2HD as indicated by the absence of alternating intensities In spite of the high concentration of the heavy water used no bands due to C_2D_2 have been observed in this region

So far, the fine structure of the strongest two bands (1·030 μ and 1 094 μ) has been measured The moment of inertia of C_2HD in its lowest state was found to be 27 90 × 10^{-40} gm cm^2 From the moment of inertia of ordinary C_2H_2 (23 50 × 10^{-40} gm cm^2) alone, it is impossible to get exact values for both the C–C and C–H distances It is now possible, however by combination of the moments of inertia of C_2H_2 and C_2HD to get an accurate value for both these distances without making any outside assumptions (Naturally the nuclear distances are supposed to be the same in both molecules) The result is $r_{CC} = 1\ 205$ A and $r_{CH} = 1\ 062$ A

As C_2HD is not symmetrical part of the selection rules valid for C_2H_2 no longer hold Therefore more transitions occur in C_2HD than in C_2H_2 This fact is illustrated by the accompanying table where preliminary values for the origins of the C_2HD bands are compared with the corresponding C_2H_2 bands The nomenclature of Mecke[2] is used with Lochte Holtgreven and Eastwood's[3] interpretation of the C_2H_2 bands The combinations $2\nu_a + \nu_1$ and $2\nu_a + \nu_2$ are forbidden for C_2H_2 according to Dennison's selection rules but not for C_2HD As will be seen the strongest band $3\nu_a$ is slightly shifted to *shorter* wave lengths in spite of the larger mass of one of the vibrating nuclei whereas the band $\nu_a + 2\nu_1$ is appreciably shifted to *longer* wave lengths It follows that $\nu_a \approx 3300$ cm^{-1} $\nu_1(s) \approx 2650$ cm^{-1} against 3277 and 3230 respectively in C_2H_2 This frequency shift is somewhat analogous to that observed by Wood[4] in the Raman spectrum of HDO

	C_2HD	C_2H_2
$3\nu_a$	9706 cm^{-1}	9641 cm^{-1}
$2\nu_a + \nu_1$	9139	—
$\nu_a + 2\nu_1$	8550	9835
$2\nu_a + \nu_2$	8410	

We are preparing to investigate HDO (H_2D, DCN and other heavy molecules in the same spectral region

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[1] H M Randall and E F Barker (Phys Rev 45 124 1934) have recently published a short note on the *far* infra red spectrum of C_2HD and C_2D_2
[2] R Mecke Z phys Chem, B 17 1 1932
[3] W Lochte Holtgreven and E Eastwood Z Phys 79 450 1932.
[4] R W Wood Phys Rev 45 392 1934

De Causis Plantarum

IN a review of Dr Gunther's edition of Goodyer's Dioscorides in NATURE of February 17 reference is made to Goodyer's translations of Theophrastus, and the statement is made that so far as is known the manuscript translation in the library of Magdalen College prepared by Goodyer in 1622 23 is still the only English version of De Causis Plantarum' '

It may be of interest therefore to direct attention to the fact that the text of Book I of De Causis Plantarum with translation and commentary by Robert Ewing Dengler was presented in 1927 as a dissertation for the doctor's degree at the University of Pennsylvania and was published by the University among the theses for that year

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Research Items

Wooden Cauldron from Co Monaghan, Ireland A remarkable cauldron of wood has recently been acquired by the National Museum of Ireland It was found at Altartate near Clones Co Monaghan in 1933 at a depth of 160 cm in a peat bog 356 cm above the clay at the foot of the deposit The cauldron was undoubtedly complete when it was found but was broken by the finder and onlookers The remains have been restored by Prof J Bayley Butler and has been described by Dr A Mahr (*Proc Roy Irish Acad* 42 Sec C No 3) The dimensions are opening 34 cm × 35 cm external measurement 45 cm × 49 cm height 28 5 cm thickness 0 9 cm near rim to 2 cm The vessel is now slightly elliptical doubtless owing to warping The wood is poplar, the handle only one remaining of yew The cauldron is unique owing to the handles and the ornamentation on the upper portion The handle something between a triangle and a semi circle is a translation into wood of the ring handles of the well known riveted cauldrons of the late bronze age of Britain the ribbed lugs carved out of the solid wood also being reminiscent of the metal staples found in these cauldrons but the lugs of the Altartate vessel are on the shoulder the difference being due to the material The ornamentation consists of six concentric patterns with central dots encircling the upper portion The circles which are not closed are connected with each other by tangential bands these being a continuation of the bands forming the incomplete circles The concentric pattern is a faint reminiscence of the old metal rivets but has become purely ornamental Looked at as a whole the pattern has a step character like a debased spiral ornament No similar pattern is found in the Irish bronze age and it seems to be nothing but a clumsy expression of a provincial La Tène art The vessel may therefore be a belated descendant of metal cauldrons which had gone out among the well to do but lingered among the poorer classes The suggested date of early iron age is confirmed by a pollen analysis by Prof Knud Jessen

Diving Powers of Whales It is little likely that the physiological processes of the larger Cetacea will ever become known from direct observation For this reason Mr A H Laurie has felt that it would be well worth while to undertake a careful and detailed study of the properties of fresh carcases of the Southern Blue and Fin whales in the belief that he might thereby be enabled to make tentative but nevertheless useful deductions as to their mode of life The results of his observations and experiments (Discovery Reports 7 363 406 1933) provide striking confirmation of the soundness of this belief After analyses of the data which he has been able to collect Laurie supports the view—stoutly opposed by certain cetologists—that whales are capable of diving quickly to great depths and as rapidly returning again to the surface If this indeed be true (and the bulk of the evidence seems to point to this conclusion) certain physiological considerations of great interest are involved the most important of which is the whale s immunity from caisson sickness On the basis of human performance a whale which dives to a depth of 100 metres and stays down there for 15 minutes will require to spend rather more than 1½ hours in returning slowly to the surface in order to avoid this malady Yet all whalers are agreed that whales rise from deep soundings much more quickly than that Up to the present no convincing reason why whales enjoy immunity from caisson sickness has ever been put forward A very surprising yet exceedingly plausible explanation is now indicated by the results of Mr Laurie s observations and experiments He has found that whale blood both adult and foetal contains vast numbers of tiny bacteria like organisms provisionally referred to as X organisms These *X* organisms appear to possess the power of bringing about some kind of nitrogen fixation with the result that excess nitrogen dissolved in the blood under extra pressure does not escape from it on decompression and cause caisson sickness in the animal (see also NATURE 133 636 April 28 874 June 9 1934)

Adoption of an Orphaned Brood by a Wasp In the *Entomologist s Monthly Magazine* for April 1934 Mr G E J Nixon describes the finding of a rudimentary nest of *Vespa vulgaris* containing sixteen cells and of about the size of a golf ball The nest was dug out from the ground along with the queen and carried indoors The queen made no attempt to leave the nest until it was indoors and then it flew to a window The nest was suspended across the top of a fairly large and deep box and after several attempts to escape the queen was ultimately induced to adopt the new abode and was regularly fed At the time when the nest contained two cocoons and many larvæ of different sizes she disappeared and was not seen again Three days later a queen of the allied species *V germanica* was obtained, and this individual adopted the orphaned brood just as completely as if it were her own She accepted blow fly puparia and caterpillars which she malaxated and fed to the brood The experiment was brought to a conclusion owing to an accident which caused the comb to fall and become broken

Sex in the Myxomycetes A paper by S Abe in vol 1 of the Science Reports of the Tokyo Bunrika Daigaku (Tokyo University Koishikawa Tokyo) describes some very interesting experiments on male and female gametes of various slime fungi (On the Syngamy of some Myxomycetes pp 193–202 Jan 23 1934) The work deals with the planogametes of *Fuligo septica Ericonema aureum Didymium nigripes, Physarum crateriforme* and *Stemonites fusca* It was observed that one of the gametes (the male) moved towards the other and the two can be further differentiated by staining reactions Neutral red safranine neutral violet methylene blue and cresyl blue all stain male and female gametes differently The female gamete has a positive charge whilst the male is negative

Ice in the Arctic Seas. The survey for 1933 of ice in the Arctic Seas (*Isforholdene i de Arktiske Have*) by the Danish Meteorological Institute shows that unusually favourable conditions prevailed in the Barents and Greenland Seas where for the greater part of the year the ice was well to the north of the average limits Off Spitsbergen there was no ice to the west in winter and spring or from the middle of June through the summer and autumn The north coast was clear from May until August and the east coast was almost clear in August Novaya Zemlya was almost clear in July and entirely clear in August in which month Franz Josef Land was accessible in open water Not during the last 34 years have conditions been more favourable on the east coast of Greenland In March and April the edge of the pack was 120 miles west of its normal position and by August the whole coast between lat 70° N and Cape Farewell was clear of ice The coasts of Iceland were free throughout the year On the Newfoundland Banks ice was rare except in May Davis Strait was unusually clear in most months Hudson Strait was almost clear in August On the other hand conditions were severe in Bering Strait and the Beaufort Sea and towards Wrangel Island North of Asia so far as information goes the ice was abundant but it was mainly new ice The White Sea did not clear until May On the whole it would appear that the outflowing polar drift was checked in the Barents and Greenland Seas and diverted towards Alaska and eastern Siberia

Three Commercial Sands of Canada Several reports of the Canadian Department of Mines published early this year have reached us these appear to be mainly of interest to Canadians but one Investigations of Mineral Resources makes a somewhat wider appeal This pamphlet contains three papers all referring to certain sandstones the first is an account of a bed of Potsdam sandstone between Buckingham and Gatineau Point Quebec it appears to be a friable sandstone easily disintegrated into individual quartz grains which are rounded to subangular The authors (L H Cole and R K Carnochan) conclude that this deposit will probably yield a silica sand sufficiently free from iron for glass making The second paper by L H Cole refers to a band of Chazy sandstone at Hawkesbury Ontario The stone appears to be fine grained and strong is easily carved and worked and apparently would make a good building stone for which purpose it appears to have been used for something like a hundred years The third paper gives an account by S C Ells of the bituminous sands of McMurray Northern Alberta The author holds and has held for a considerable time that the McMurray deposit of bituminous sand should be regarded as a potential source of liquid hydro carbons The quantity of available bituminous sand appears to be very large it is assumed that its bitumen content is 12½ per cent and that the petroleum products derived from the bitumen would be about 75 per cent by volume of the bitumen The author estimates costs of production and shows that the material can be worked at a profit, and concludes that the conditions are favourable to commercial development of the Alberta bituminous sands '

Treatment of 'Slurries' in Coal Washing Every advance in technology creates new problems The need for cleaner coal led to development of coal washing But coal is friable and contains dust which interferes with the efficiency of most washing processes Therefore the dust may not be permitted to accumulate in the wash water, and tanks are provided where the dust is allowed to settle and form a slurry or mud of particles of coal and earthy matter Owing to the fineness and character of the dust particles the clarification of the wash water is often difficult and chemical precipitants are added to promote flocculation and deposition of the slurry This may contain more water than fuel and must be dewatered, after which it may be used as a low grade fuel or incorporated in the slack fed to coke ovens The dedusting of coal and the treatment of slurries form the subjects of Memoranda 13 and 14 of the Institution of Mining Engineers During coal strikes, accumulations of slurry have proved unsuspected fuel reserves of no small importance

Hot Wire Anemometers. The lecture on these instruments and their uses given at the Institut de Mécanique des Fluids of the University of Paris by Dr E G Richardson of Armstrong College Newcastle in March 1932 has been amplified by him and issued as an Institut pamphlet with the title Les Appareils à Fil Chaud (Paris Gauthier Villars) It extends to 68 pages and is well printed and illustrated After showing how the change of resistance of a wire carrying an electric current due to the movement past the wire of the gas or liquid in which it is placed may be used to determine the speed of the fluid he shows how by placing two wires parallel to each other and near together the sheltering action of one wire to the other allows the direction of the motion of the fluid to be determined The effects of to and fro movements of the fluid and of solid walls are also traced The second part gives an outline of the results obtained by these methods for the motions of the air about the wings of an aeroplane about a cylinder and in the pipes and cavities of musical wind instruments References to 62 papers dealing with the subject are given There are a few misprints Fig 2 p 16 and Camobell p 57 are examples

Atomic Weight of Cæsium The atomic weight of cæsium in use for some time rests on the work of Richards and Archibald and Richards and Françon who found the value 132 81 Aston and Bainbridge however found by the mass spectrograph that cæsium is a simple element and Aston s packing fraction together with the conversion factor from O^{16} to O 16 of 1 00022 leads to Cs 132 904 A redetermination of the atomic weight by chemical methods using cæsium from pollucite of Maine U S A made by G P Baxter and J S Thomas (*J Amer Chem Soc* May) has given a result in close agreement with that of Aston although sufficient reasons for the difference between their results and those of Richards and his collaborators are difficult to discover The cæsium salts were very carefully purified and showed no trace of rubidium or potassium on spectrographic examination The chloride was fused in a platinum boat in an atmosphere of nitrogen hydrogen, or various mixtures of hydrogen and hydrogen chloride before weighing The silver precipitation method with adjustment of the end point with a nephelometer, was used Fourteen experiments are reported the average ratio CsCl Ag being 1 56063 or Cs 132 903 By rejecting one experiment which gave rather low values the averages are CsCl Ag = 1 56065 and Cs = 132 906 The values for the first seven determinations for which probably the material was of slightly better quality are CsCl Ag 1 56070 and Cs = 132 911, the value finally adopted being Cs = 132 91 It is very reassuring that the chemical and physical methods have been found to agree so well in this region of the atomic weight scale, and that a supposed anomaly has been removed

Callender's New High-Voltage Research Laboratories

THE new high voltage research laboratories of Callender's Cable and Construction Co., Ltd., are being opened on June 22 by Lord Rutherford, before a distinguished company, which will include the Council of the Institution of Electrical Engineers, by special invitation of the president, Mr. P. V. Hunter. The laboratories occupy the buildings of the old Kensington and Notting Hill Gate Power Station, at 38 Wood Lane, W. 12. The large space and head room provided by these buildings have made them especially suitable for conversion to high voltage laboratories. Altogether, 30,000 sq. ft. of ground floor space have been equipped as research laboratories, together with associated stores and workshop. The laboratories have been organised and equipped in a manner which will enable research work to be carried out in any field associated with the transmission of electrical power.

The main high voltage equipment consists of two transformers by Ferranti, each for 500 kva. continuous output at 500,000 volts. It is believed that these are the largest transformers of this voltage available at present in the industry. The large size of the transformers has been made necessary by the large capacitance current which is required for cable testing at high voltage. These two transformers are situated in adjoining laboratories which are 130 ft. long, and 45 ft. and 28 ft. wide respectively. One of these transformers has been mounted on porcelain insulators, so that the tank of the transformer can be raised to a voltage of 500 kv. to earth. In addition, a large opening in the wall dividing the two laboratories enables the two transformers to be connected in parallel or in cascade, thus providing 1,000 kva. at either 1,000 kv. or 500 kv. The lay out of these two laboratories represents a distinct departure from the usual practice in high voltage laboratories. The two transformers have been located in the middle of the laboratories. Each transformer thus commands two testing areas, one on each side. In this way, it is possible for preparation work to be pressed forward in one area while the transformer is testing in the other area, with a complete absence of risk to the personnel concerned. It is a general experience in high voltage laboratories that the preparation time far outweighs the time spent in actual testing. It has been found, however, that the above arrangement of the transformers makes for efficient use of the testing equipment.

The question of supply to the transformers received very careful consideration. It was required that high voltage should be available at any frequency between 25 cycles and 75 cycles per second. At the same time, the very sharp response curve of the vibration galvanometer used in making dielectric loss angle measurements made it essential that, when testing at any given frequency, the alternator speed should be held absolutely constant with variation of load or with variation of such factors as the supply voltage. It was not found possible to obtain sufficiently constant speed regulation with the usual arrangement of a Ward Lennard set. The arrangement finally selected consists of a 3-phase synchronous motor, driving a 3,000 volt single phase alternator through a fluid gear box, which provides a continuously variable gear ratio over the above range. All this equipment is by Haslam and Newton, Ltd., of Derby. From the testing which has so far been carried out, it appears that this equipment is likely to prove entirely satisfactory.

The cable life testing laboratory contains transformer equipment by British Thomson Houston Co., Ltd., which enables long lengths of buried cable for 66 kv. and 132 kv. systems to be tested at twice working voltage under conditions which simulate service conditions. The two high voltage transformers are for 500 kva. and 1,000 kva. respectively. These transformers are supplied by 3,000 volt single phase alternators, direct coupled to 3 phase synchronous motors. In addition to the high voltage transformers, two loading current transformers supply a total of 1,500 amp., the high current windings being insulated from earth for 170 kv. This enables cable heating current to be superimposed on the cable conductor without interrupting the high voltage, and in this way the cables are passed through periodic heat cycles. An unusual feature of this transformer equipment is that double electrostatic screens have been provided between the primary and secondary windings for the purpose of enabling accurate dielectric loss angle measurements to be carried out on cables which are buried, and in which, therefore, the cable sheaths are necessarily earthed. The cables are buried in runs of about 200 yards in land adjoining the laboratories which consists of made up soil representative of normal London conditions.

In addition the laboratory possesses a large amount of smaller transformer equipment for voltages up to 120 kv. which is used for the development of cable accessories such as joints and sealing ends, and for general investigations into the theory and mechanism of breakdown of high voltage cable dielectric.

Smaller laboratories are provided for dielectrics, chemistry and physics, and these provide all facilities for a large number of investigations which arise out of the main research programmes on the high-voltage cables themselves.

Conversion of Municipal and Village Wastes into Humus

ALTHOUGH at the moment many agricultural regions are more concerned with the profitable marketing of their surplus produce than with methods designed to increase crop production, nevertheless there are important exceptions to this general rule. In India, for example, the food supply of the villages, some 500,000 in number, is markedly deficient in amount, while the low quality is considered by many medical authorities on the spot to be one of the chief factors responsible for the poor general health and want of resistance to disease on the part of the population. In other parts of the tropics the maintenance of the food supply of the people is always one of the major anxieties of the authorities. In such circumstances any practicable method, by which the local food crops can be improved and to some extent ensured will at once command attention Such a method has recently been worked out at the Institute of Plant Industry at Indore in Central India The earlier results were published by Messrs Howard and Wad in 1931 as The Waste Products of Agriculture which was reviewed in NATURE of November 21, 1931 In the February number of the *Indian Medical Gazette* of the present year Messrs Jackson and Wad have successfully applied the Indore method of manufacturing humus from agricultural wastes to the conversion of night soil and town refuse into a valuable compost*

During 1932 and 1933 town wastes have been converted into humus at three centres—(1) Indore City where the waste products of 60 000 inhabitants were dealt with, (2) the Indore Residency enclave with a population of 4 000, and (3) the lines of the Malwa Bhil Corps where the numbers are about 1 000 These three centres are representative of a large municipality a small town or military cantonment and an ordinary Indian village The arrangements for the conversion are very simple and inexpensive The humus factory consists of (1) a metalled service road 20 ft wide (2) a charging trench on either side 2 ft deep and 15 ft wide the floor and sides of which are preferably made smooth and impermeable so as to prevent the breeding of flies and (3) metalled storage areas at least 20 ft wide on which the ripe compost can be piled in heaps until it is sold The manufacture of compost which takes about a month consists in the proper arrangement and moistening of the raw materials—town and village refuse and night soil in the charging trench followed by the turning of the charge three times at suitable intervals An intense fermentation accompanied by a rapid rise in temperature to above 50° C at once sets in The copious aeration which is ensured by the proper admixture of the materials leads to the rapid oxidation of the organic matter and to the destruction of all noxious odours while the high temperature destroys the fly maggots and probably the ova of helminths and the spores of pathogenic bacteria as well

The chemical composition of the final product is very satisfactory The percentage of nitrogen on a dry basis is nearly 1 per cent while the percentages of phosphorus potash and lime are ample The results obtained with such crops as sugar cane wheat cotton lucerne and vegetables are such that the product finds a ready sale The sale proceeds are considerably greater than the cost of manufacture and therefore a substantial profit is obtained instead of the usual loss During the last year at Indore City for example a net profit of Rs 3 085 was obtained Under the old method of disposal at this centre the net deficit was Rs 4 535 From the point of view of sanitation and public health two of the medical officers in Central India—Colonels Tyrrell and Nicholson—record their opinion on the process Both consider that the method is likely to prove the most satisfactory system so far employed for the disposal of municipal wastes

The Indore results are already being taken up at other centres in India The process has been adopted by the Military Cantonment at Neemuch and at Okara a small town of 9 000 inhabitants in the Punjab At the suggestion of Sir Malcolm Hailey the Governor of the United Provinces the Public Health Department has decided to experiment with the method while the Public Works Department of New Delhi is examining the process with the view of applying it as a solution of their very serious refuse disposal problem

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* Institute of Plant Industry Indore, Central India Bulletin No 1 The Sanitary Disposal and Agricultural Utilisation of Habitation Wastes by the Indore Process By F K Jackson and Y D Wad, with Notes on the Sanitary Aspect by Lieut-Col J R J Tyrrell and Lieut-Col M A Nicholson Pp 26+3 plates (Indore) 8 annas

Measurement of Noise

IN a paper read to the Institution of Electrical Engineers on March 8 Messrs B G Churcher A J King and H Davies read a paper on experiments on the measurement of noise, with special reference to engineering noise problems (see also NATURE 132 350, Sept 2 1933)

The authors point out that the old conception that sounds can be classified into music and noise is untenable For their purposes they define noise as irksome or undesired sound For example, the sound of a radio set operated in a room to the pleasure of some of the occupants may constitute an irksome noise to others who wish to converse They discuss the laws governing the threshold of hearing the relation of the magnitudes of the stimuli at different frequencies which produce equal sensations of loudness and the relation between stimulus and sensation They define the threshold as the largest sound the complete removal of which is not detected

In determining the threshold, it is essential that there is no background noise The range of frequencies covered is 100–6,400 cycles per second at octave intervals so that measurements were made at seven frequencies Points determined in this way are sufficiently close to define the threshold curve

The experiments were carried out in the laboratories of Metropolitan Vickers Electrical Co Ltd Fifty persons were experimented on and were divided into male and female groups At 100 cycles per second the female group is 2 3 decibels less sensitive than the male At 800 cycles per sec there is a tendency in both groups for sensitivity to decrease with increasing age but the female group is now 2–3 decibels more sensitive than the male At 6 400 cycles per sec the average sensitivities of the two groups are approximately equal the three oldest males having a much lower sensitivity than the rest

The old loudness scale used by the authors and the decibel scale are logarithmic scales of physical stimulus Doubt is thrown on the correctness of this method of measuring sound sensation Experience has shown that the rate of increase of loudness with the decibels above the threshold is comparatively small at low intensities and much larger at high intensities Masking and balancing methods of measuring the noise were experimentally tried and the latter was found much the more satisfactory A pure tone was taken as the standard sound as it is easy to specify and reproduce accurately The procedure is to find the physical magnitude of the standard stimulus which produces a loudness sensation of the same magnitude as that due to the source under observation The judgment of loudness equality is much simpler than the estimate of the magnitude of loudness It was most important that the response of the telephones used should have a linear relation with the amplitude of the disturbance especially at high values of the amplitude

The authors have made measurements of the magnitudes of common noises on various scales In what follows, we give them in loudness units Calling zero the threshold of hearing, the ticking of a watch at three feet would be unity In a quiet saloon motor car it would be 10 Ordinary conversation at three feet would be 20, but if in a suburban steam train with the window open it would be 50 A loud motor horn at 100 feet was found to be 100 and two circular saws at three feet 160

The effect of placing the source inside a building is very pronounced An 800 cycle tone placed in an enclosure had a loudness of 41, whilst outside it was only 2 4 In making these measurements it is vitally important to take the background of noise into consideration It is a matter of everyday experience that one sound can drown another A list of typical noise levels is given For example, a busy main street in a certain city had a noise level of 22 When trains were passing it rose to 53 On a weekday on the ground floor of an office in the street with the windows open, the noise level was 22, but shutting the windows reduced it to 11 On a Sunday morning with the windows open it was 0 6 and closed 0 2 In a dining car in a train travelling at 60 miles per hour the level was about 50, but in a tunnel it rose to 82

When apparatus is installed near a main street in a busy city, we have to consider a background of between 20 and 50 In this case a comparatively loud noise is scarcely noticed On the other hand, when a residential hotel has to be considered, special precautions have to be taken The screening effect produced by adjacent buildings is sometimes of assistance At certain hours of the night the background may be so low as 1 unit and a much lower noise emission would have to be aimed at If the problem is to be adequately dealt with in quiet residential districts some form of enclosure must be used

Permeability Tuning in Radio Frequency Circuits

VARIABLE condensers are now so commonly employed in radio receivers to tune circuits including a constant inductance that the use, some years ago, of variable inductances or variometers with fixed condensers is apt to be forgotten For some purposes however the latter arrangement may have considerable advantages A paper by W J Polydoroff[1] refers to the advantages, particularly in the matter of selectivity, which result from tuning radio receiver circuits in such a manner that the ratio of the inductance to the resistance of the circuit remains constant These desirable results may be conveniently accomplished by a new type of ferro inductance The coil itself is designed to have the desired performance at the highest frequency in the band to be covered The effective inductance is then increased to tune to lower frequencies by introducing a magnetic core into the field of the coil As the core is inserted into the coil, more lines of the magnetic field are intercepted by the core, and in effect, the average permeability of the medium surrounding the coil increases from unity, for air, to a certain maximum when the coil is entirely encased in the core hence the term permeability tuning'

The successful application of this principle to radio frequency circuits depends upon the production of an iron core material having an appreciable permeability at the working frequency, but free from the property of introducing undesirable resistance into the circuit For many years, thinly laminated iron and stranded cores have been used for audio frequencies while compressed iron dust cores have also come into use for frequencies up to about 50 kilocycles per second Quite recently considerable attention has been paid to the use of both iron and high permeability alloys for the construction of these dust cores, in order to obtain the necessary high permeability without the accompaniment of serious losses at radio frequencies

In his paper, Polydoroff describes the use of pure iron reduced by hydrogen as a primary material for radio cores While hysteresis losses are apparently vanishingly small at radio frequencies, the eddy currents are proportional to the square of the frequency and to the length of the circular path around each minute particle The research described was directed at the broadcast frequency band, 550-1,500 kilocycles per second, and in this band the optimum grain size of the iron proved to be about 5 microns in diameter This iron powder is mixed with a suitable insulating varnish and compressed in heated moulds of the desired shape using pressures up to twenty five tons per square inch The resultant product has the appearance of solid iron, exhibits fair mechanical strength, and can be machined in the usual manner The effective permeability obtained in such materials varies from about 5 to 12 according to the pressure employed in the moulding process

The paper describes the use of this type of iron core in various types of radio receiver circuit A good quality single layer solenoid of small dimensions is used as the inductance, and the core is made of two parts, an outer cylindrical shell and an inner plug, so as to enclose the coil in the position of maximum inductance A semi fixed condenser is attached to the end of each coil, and this is initially adjusted to give resonance at the highest frequency required The cores are mounted on a common platform and inserted in their respective coils by a single tuning control Provision is made to move each coil or each core separately in order to produce synchronisation at the middle of the range

In receivers employing as many as six tuned circuits, no difficulty has been experienced in maintaining synchronism and constancy of the inductance to resistance ratio throughout the whole frequency band The arrangement is equally applicable to the supersonic heterodyne and the straight radio frequency amplifier types of receiver, and the advantages of the latter with the possibility of increased selectivity may give rise to interesting developments in the future

[1] Ferro-Inductors and Permeability Tuning , *Proc Inst Rad Eng*, May, 1933

University and Educational Intelligence

CAMBRIDGE —The title of Stokes lecturer in mathematics has been conferred on Dr M Born

Prof E A Owen professor of physics at University College Bangor of Trinity College has been approved for the degree of Sc D

The subject for the Sedgwick Prize for the year 1937 is The Application of Modern Technique to the Elucidation of Some Specific Geological Problem The prize is open to all graduates of the University and essays are to be sent in on October 1 1936

OXFORD —The question of the provision of sites in the University Park for the extension of the science departments which has lately given rise to much discussion has been settled by the adoption of certain decrees by Congregation By these it is provided that in addition to the area at present reserved a further area on the western frontage should be allotted for such extension when required while the remainder of the Park should be declared a public open space This arrangement has been approved without opposition though it would appear that if the requisite negotiations under the provisions of the Town and Country Planning Act 1932 are carried through the University will to some extent have forgone its freedom of action with respect to the portion not reserved for science

THE following International Lady Tata Memorial Scholarships each of the value of £400 for the academic year 1934 35 for research work in diseases of the blood with special reference to leukæmias have been awarded Dr W Bungeler (Danzig) Dr L Doljanski (Copenhagen) Dr M C G Israels (Manchester) Dr C Oberling (Paris) Dr J Engelbreth Holm (Copenhagen) Dr M O K Jørgensen (Aarhus Jutland) Dr R Meier (Leipzig) Dr Lucy Wills (London)

LEHRFREIHEIT manifestoes by organisations representing twenty two thousand American professors have been recently promulgated They are reviewed in a Press *communiqué* circulated on March 12 by the Institute of International Education of New York Specific reference to any foreign country is avoided but recent events in Germany are doubtless responsible for these declarations which do not ignore the fact that the United States itself is not immune from attacks upon academic freedom The following excerpts are typical American Association for the Advancement of Science— Our existing liberties have been won through ages of struggle and at enormous cost If these are lost or seriously impaired there can be no hope of continued progress in science of justice in government or international or domestic peace or even of lasting material well being Whether by governmental action, administrative coercion or extra legal violence we feel it our duty to denounce all such actions as intolerable forms of tyranny American Political Science Association— Every people has the right to live under the form of government it selects for itself It is not for outsiders to object because they do not like it But it is reasonable to deplore an action anywhere that may be absolutely destructive of gains in human progress that have been made only by great sacrifice Freedom of teaching is one such gain "

Science News a Century Ago

Sir Gilbert Blane, F R S

June 26 marks the centenary of the death of Sir Gilbert Blane F R S who with Robert Lind contributed more than anyone else to naval medicine and hygiene and the welfare of seamen He was born at Blanefield Argyllshire on August 26 1749 and received his medical education at Edinburgh under the celebrated William Cullen After obtaining his M D degree at Glasgow in 1778 he went to London became private physician to Sir George Rodney and accompanied him on a voyage to the West Indies On his return he submitted to the Board of Admiralty a memorial on the lack of cleanliness ventilation and dryness in ships the need for a supply of lemon juice for the prevention and treatment of scurvy the prevalence of drunkenness the inadequate care of the sick aboard ship the absence of proper bedding and soap and the need of a free supply of medicines and other necessaries to naval surgeons In 1782 he left Plymouth with Rodney and remained on active service until the end of the War with the American Colonies during which time he collected materials for his principal work entitled Observations on Diseases of Seamen" published in 1785 This book consisted of three parts devoted respectively to the health and diseases of the Fleet during the years 1780–83 the causes and prevention of diseases in fleets and the description and treatment of affections such as fevers dysentery and scurvy most frequently seen at sea During the last forty years of his life Blane was frequently consulted by the Government and others on various aspects of public health especially in connexion with the Navy

Babbage and Parliament

In his Passages from the Life of a Philosopher Babbage gives an entertaining account of the elections in which he took part On more than one occasion he was invited to become a candidate for Parliament and on June 27 1834 was nominated for Finsbury In proposing his name Mr F O Martin said that although Mr Babbage had never been in Parliament before that did not take from his utility He had however laboured to serve the public in other capacities and had the honour of being the successor in an office formerly filled by the illustrious Newton He was an advocate for the emancipation of the Jews and the removal of the disabilities affecting their Dissenting brethren

The candidature of Babbage was not regarded with favour in some quarters as there were three other candidates, and in the end his name appeared at the bottom of the poll with 379 votes while the two successful candidates secured 2 514 and 1 915 votes respectively In his Passages when recalling that he afterwards declined the honour of standing for Stroud he wrote I was not particularly desirous of wasting my time for the benefit of my country The constituency of Finsbury had already expressed their opinion that Mr Wakley and Mr Thomas Duncombe were fitter than myself to represent them in Parliament and in that decision I most cordially concurred

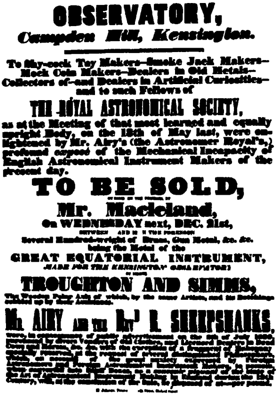
Travels of Lieut A Burnes

On June 28 1834 the *Athenæum* began a long review of the Travels into Bokhara of Lieut

Alexander Burnes with the remark that Since the days when we hung with rapture over the pages of Cook s voyages and felt ourselves inspired by some portion of the enthusiasm that animated the adventurous navigator we have met with no work by which we have been more interested delighted and instructed than the travels of Lieut Burnes Born at Montrose on May 16 1805 Burnes at the age of sixteen years entered the Indian army He became well acquainted with Oriental languages and soon gaining promotion, became an assistant political officer and was sent on various missions In 1832 at his own request he was sent on a twelve months expedition into Central Asia By his success in this expedition one writer said our traveller at once became famous He had retraced the greater part of the route of Alexander surveyed the kingdoms of Porus and Taxiles sailed on the Hydaspes crossed the Indian Caucasus, beheld the scenes of the inroads of Jengis and Timour and Baber but more than this he had detected a new pathway by which India might be invaded From this journey Burnes in 1833 returned home to receive the medals of the Geographical Societies of London and Paris and to be lionised by society Returning to India in 1835 he was employed by the Government on a mission to Afghanistan and six years later lost his life in the terrible massacre of November 1841

Sir James South s Telescope

Referring to the note in these columns under this title in NATURE of June 9 p 882 Messrs Sir Howard Grubb Parsons and Co inform us that they have a copy of the extraordinary poster which Sir James South used to advertise the sale of his great equatorial telescope The accompanying reproduction is from a photograph of the poster



OBSERVATORY,
Campden Hill, Kensington.

To Sky-cock Toy Makers—Smoke Jack Makers—
Mock Coin Makers—Dealers in Old Metals—
Collectors of—and Dealers in Artificial Curiosities—
and to such Fellows of
THE ROYAL ASTRONOMICAL SOCIETY,
as at the Meeting of that most learned and equally upright Body, on the 13th of May last, were enlightened by Mr. Airy's (the Astronomer Royal's,) profound *exposé* of the Mechanical Incapacity of English Astronomical Instrument Makers of the present day.

TO BE SOLD,
Mr. Macleland,
On WEDNESDAY next, DEC. 21st,
Several Hundred-weight of Brass, Gun Metal, &c. &c.
being the Metal of the
GREAT EQUATORIAL INSTRUMENT,
MADE FOR THE KENSINGTON OBSERVATORY
TROUGHTON AND SIMMS,

MR. AIRY AND THE REVD R. SHEEPSHANKS,

Societies and Academies

LONDON

Physical Society, June 1 G F HULL, S E GREEN and MARY BELL The pressure of radiation A historical statement A brief account of some early experiments on radiation pressure dealing in particular with the investigations of Lebedew and of Nichols and Hull A H JAY The estimation of small differences in X ray wave lengths by the powder method It has been found possible by the use of a microphotometer to determine accurately the positions of lines at high angles of reflection on a powder photograph With a powder photograph of clear colourless quartz taken with copper K_a radiation the distance apart of the two component lines of a well resolved doublet was measured to within 0 0002 cm The measurements were then corrected for systematic errors—eccentricity of specimen absorption of the radiation in the specimen, and divergence of the X ray beam The wave length difference $(\lambda_2 - \lambda_1)$ was finally calculated in terms of the given wave length λ_1 The value of $(\lambda_2 - \lambda_1)$ for copper K_a radiation is given as 3 833 X H STAFFORD HATFIELD The action of alternating and moving magnetic fields upon particles of magnetic substances An explanation of the translatory movement observed by Mr W M Mordey in magnetic particles subjected to a multi phase alternating field A MORRIS CASSIE Time scale and electron relay used with a cathode ray oscillograph for the investigation of switch gear and circuit phenomena E GWYNNE JONES Note on the hyperfine structure in the arc spectrum of xenon The hyperfine structures of the Xe I lines λλ 9045 9799 and 9923 are described and analysed and the hyperfine separations of the terms $2p_9$ and $2p_{10}$ are derived It is also found that the lines $1s_5 - 2p$ are readily self reversed Previous nuclear spin data are confirmed

PARIS

Academy of Sciences, April 30 (*C R* 198, 1557 1644) P VIALA and P MARSAIS The biology of *Pumilus medullæ* the cause of the parasitic *court noué* of the vine This parasite belongs to the family of the Sphæriaceæ it forms a new genus near the genera *Xylaria* and *Eutypa* BORIS KAUFMANN General closed surfaces and the local dimension GEORGES KUREPA Ramified tables of *ensembles* MAURICE JANET Systems of two partial differential equations with one unknown function of *n* independent variables ANDRÉ MAGNIER The integral of Kronecker F MARTY The modulus of the Maclaurin coefficients of a univalent function G DEDEBANT PH SCHERESCHEWSKY and PH WEHRLE The statistical similitude in turbulent movements of fluids MAX SERRUYS The passage from the deflagrating to the detonating regime in petrol motors JEAN LOUIS DESTOUCHES The definition and properties of the centre of gravity in wave mechanics HENRI MINEUR Researches on the movements of the *B* stars J GÉHÉNIAU The magnetic electron and the correspondence principle of Th De Donder and J M Whittaker BERNARD KWALL A system of real matrices which interpose in the theory of the magnetic electron when placed in space time of special relativity PIERRE VERNOTTE How to approach the problems of the propagation of heat with fixed boundaries when the thermal properties of the medium depend on the temperature Albert Milhoud The electromotive force produced by the flow of steam Study of the effects of variations of diameter and length of tubes forming the jets and pressure of the steam on the electromotive forces produced The latter may amount to several thousand volts: a super heat of 30° C completely suppresses the electrification N Stoyko The interference of short electric waves in the case of superpropagation F Trombe The magnetic properties of metallic cerium, lanthanum and neodymium at various temperatures These experiments the results of which are given as curves, were carried out on exceptionally pure specimens of the metals M Dodero The preparation of calcium silicide by high temperature electrolysis The electrolysis of calcium silicate, with the addition of calcium fluoride and chloride, gives alloys of free silicon and the silicide $CaSi_2$, the proportion of free silicon diminishing with the temperature J Devaux Study of the solar spectrum in the extreme infra red René Coustal The action of the silent electric discharge on certain phosphorescent substances J P Mathieu The configuration of some optically active hexacoordinated complex compounds Ivan Peychès The rotatory power of the tartrates of the alkaline earths R Arnoult The magnetic spectrum of the β rays emitted by thorium $B+C+C'+C''$ René Dubrisay A method of capillary analysis Mlle Paulette Berthier The soaking of porous bodies by liquids Raymond A method of separating antimony and tin The method is based on the use of triethylolamine, $N(CH_2CH_2OH)_3$, as a reagent F Diénert and F Villemaine The estimation of small quantities of nitrates in waters rich in organic matter Henri Wahl The nitration of chloro *p* xylene Charles Dufraisse and Arnaldo Peres de Carvalho An attempt at the preparation of rubenes derived from fluorene formation of a red non rubenic compound Internal tensions and the probabilities of formation of rubenes N Menchikoff The southern bank of the Jurassic Mésogée in Algero Moroccan borders Raymond Furon and Conrad Kilian The discovery of the Senonian at Damergou (French Niger) Jacques de Lapparent The development of the Rosaline limestones in Greece Mlle Madeleine Friant The comparative evolution of the upper molars in the primates and primitive insectivores H S Reed and J Dufrenoy The methods of calculation of the theoretical curve of growth of vine shoots Pierre Dangeard The budding of the nucleoles observed in *Lathræa Clandestina* and in some plants with prochromosomes R Reilhes The modifications of the lipid concretions (Mirande's sterinoplasts) in the bulb of *Lilium candidum* with the temperature Louis Fage The presence of luminous organs in the pelagic amphipods Léon Bertin A new species of abyssal fishes *Saccopharynx Schmidti* Raymond Hamet The influence of atropine on the intestinal effects of adrenaline G Tanret The glucoside from the seeds of *Coronilla* Pierre Grabar Study of serum proteins by filtration on membranes of graduated porosity E Wollman Researches on autolysis The specific autolysines

Melbourne

Royal Society of Victoria, April 12 Janet W Raff Observations on saw flies of the genus *Perga*, with notes on some reared primary parasites of the families *Trigonalidæ*, *Ichneumonidæ* and *Tachinidæ* This paper records the results of breeding saw flies from fully grown larvæ, collected for the most part near Melbourne since 1928 Most of the breeding has been carried out under quarantine conditions The paper includes a revision of the life history of *Perga* as seen from numerous broods of larvæ Three cases are quoted where prepupal instar was extended for an extraordinarily long period Part of the paper concerns the details of emergences of several individual broods of larvæ of emergences of adults, of the appearances of sexes, and the extent of parasitism A third part embraces notes on reared primary parasites One of the Trigonalidæ is recorded for the first time as a primary parasite, and the habits of this rare family recapitulated Evidence of lengths of stages of the Ichneumonidæ and Tachinidæ have been obtained from examination of cocoons from time to time, during breeding experiments

Vienna

Academy of Sciences, March 1 Karl Wolf Bending vibrations of an elastic strip Calculation of the frequency of such vibrations for a strip fixed at the mid points of its two ends gives an approximate value about six per cent different from that determined by one dimensional calculation H Kun Female sexual hormone and psychic heat in the female Hanns Tollner Astronomical determinations of position on Jan Mayen, continental drift Hans Hornich Remarks on a special class of Riemannian surfaces J Kisser and H Ertl Distribution of traumatic substances in cases of traumatic curves in plants Viktor Oberguggenberger Extinction of effective wave lengths

March 8 Ernst Späth and Julius Zellner Marasmin This compound obtained from the fungus *Marasmius Scorodonius* is identical with *l* leucine Georg Koller and Karl Pöpl A chlorine containing lichen constituent The constitutions of (1) monochloratranol, formed on acetolysis of an atranorin derived from *Pseudevernia furfuracea* L vars *ceratea* and *isidiophora*, and (2) its mother substance, monochloratranorin, are given Eduard Haschek Fundamental sensations (2), influence of the eye medium on the perception of colour Rudolf Kalina Calculation of the stresses in metal girders with continuous welded seams Lothar Geitler Change of form of pennate diatoms Friedrich Trauth Geological studies in the western lower Austrian Alps Viktor Pietschmann Three new fish from the coastal waters of Hawaii *Scorpaena fowleri*, *Dascyllus edmondsoni*, and *Asterropterix eumecoes* are described

March 15 Paul Ludwik and Rudolf Scheu Interference of X rays Fritz Wessely and Konstantin Dinjaški Action of light on substances of the furocoumarin type When subjected to the action of daylight or ultra violet light, pimpinellin I, a constituent of the roots of *Pimpinella saxifraga*, yields two dimerides Such dimerisation is not, however, a general property of the furocoumarins Herbert Haberlandt, Berta Karlik and Karl Przibram Fluorescence of fluorite (2) Experiments with synthetic material show that the blue fluorescence bands are to be attributed to europium and the green low-temperature bands to ytterbium A connexion between the radio photofluorescence bands and the divalent forms of the rare earths is indicated **KONRAD FUNKE** and **GREGOR PRINZ YPSILANTI** Position of the substituents in dinitroperylene **OTTO KOLLER** Fauna of southern Burgenland (Strembach Valley)

WASHINGTON, D C

National Academy of Sciences (*Proc*, **20**, 93–144, Feb 15, 1934) **JOEL STEBBINS** and **ALBERT E WHITFORD** The diameter of the Andromeda nebula A photoelectric photometer has been attached to the 100 in reflector at Mount Wilson The telescope is set on the nucleus of the nebula and measures of the sky, or of sky plus nebula, are taken at the same hour circle at intervals of 10′ in declination The data obtained indicate that the nebula is much larger than has hitherto been appreciated from photographs, the known diameter of the nebula north and south from the nucleus and the apparent minor axis or width should be more than doubled **DONALD A JOHANSEN** Haploids in *Hordeum vulgare* About 10 per cent of a commercial sample of barley gave plants with very few root tips, the seeds appeared to have more copious endosperm They proved to be haploids with seven somatic chromosomes **W F CASTLE** Possible cytoplasmic as well as chromosomal control of sex in haploid males Haploid males are only somatically male and thus cytoplasmic influence is exerted to overbalance the female tendency of the chromosomes unless dissimilar sex chromosomes are present **J L CARTLEDGE** and **A F BLAKESLEE** Mutation rate increased by ageing seeds as shown by pollen abortion The experimental seeds were *Datura* stored at room temperature for periods up to ten years **HARRIET B CREIGHTON** Three cases of deficiency in chromosome 9 of *Zea mays* **K G EMELÉUS** Notes on intensities in the spectrum OII **M H JOHNSON, JR** On the vector model for almost closed shells **G PINCUS** and **E V ENZMANN** Can mammalian eggs undergo normal development *in vitro* ? Ova from a doe rabbit of one breed were fertilised *in vitro* with sperm from a buck of another breed, and then transferred to a doe of a third breed made pseudo pregnant by mating with a vasectomised buck of a fourth breed Young were successfully born which bore none of the characters of the third and fourth breeds used Another similar transference of ova was also successful The experiments also show that the corpora lutea of pseudo pregnancy are functional **NELSON A WELLS** and **CLAUDE E ZOBELL** *Achromobacter ichthyodermis*, n sp, the etiological agent of an infectious dermatitis of certain marine fishes This organism causes a highly fatal dermal infection of *Fundulus* in Nature, the effect of which becomes serious in aquaria for *Fundulus* and also for other fish The organism has only been cultured successfully in sea water substrata It survives 40° C for 10 minutes but is killed at 45°, optimum for multiplication, 25°–30°, optimum virulence for *Fundulus*, 20°–25° Fish in water above 30° resist inoculation, and diseased fish, if acclimatised to 32°–35°, completely recover **G A MILLER** Minimum number of squares in a group when not all of them are relatively commutative **EDWARD KASNER** General theorems on trajectories and lines of force **GUSTAV A HEDLUND** On the metrical transitivity of the geodesics on a surface of constant negative curvature **EINAR HILLE** and **J D TAMARKIN** On the theory of Laplace integrals (2)

Forthcoming Events

[*Meetings marked with an asterisk are open to the public*]

Monday, June 25

ROYAL GEOGRAPHICAL SOCIETY, at 3 —Annual General Meeting

INSTITUTE OF PHYSICS (MANCHESTER SECTION), at 5—(in the Physics Department, The University) —Dr J M Nuttall Units of Matter' *

Tuesday, June 26

EUGENICS SOCIETY, at 5 15—(in the Rooms of the Linnean Society, Burlington House, W 1) —Prof F A E Crew The Inheritance of Educability in the Rat" *

Wednesday, June 27

INSTITUTE OF PHYSICS (MANCHESTER SECTION) at 5—(in the Physics Department, The University) Prof W L Bragg, Dr A J Bradley and Dr C Sykes "Alloys *

INSTITUTION OF PETROLEUM TECHNOLOGISTS, June 28–29 —Summer meeting to be held at the Royal Society of Arts, London President T Dewhurst Discussions Oil and Coal "Progress of Naphthology

Official Publications Received

GREAT BRITAIN AND IRELAND

Memoirs of the Cotton Research Station Trinidad Series B, Physiology No 6 Studies on the Transport of Nitrogenous Substances in the Cotton Plant Part 6 Concerning Storage in the Bark By T G Mason and E Phillis Pp 315–333 (London Empire Cotton Growing Corporation) 2s 6d

Royal Botanic Gardens Kew Bulletin of Miscellaneous Information 1933 Pp iv+512+56+18 plates (London H M Stationery Office) 15s net

The Lister Institute of Preventive Medicine Report of the Governing Body 1934 Pp 32 (London)

OTHER COUNTRIES

Suppléments au Bulletin biologique de France et de Belgique Supplément 17 Recherches sur la spermatogenèse des phasmes, mâles d origine bisexuée Par Dr Maurice Favrelle Pp ii+155+5 plates (Paris Laboratoire d Evolution des Êtres organisés Les Presses universitaires de France) 55 francs

Zentralanstalt für Meteorologie und Geodynamik Publikation Nr 139 Jahrbücher der Zentralanstalt für Meteorologie und Geodynamik. Amtliche Veröffentlichung Jahrgang 1928 Neue Folge Band 65 Pp xx+A42+B58+C48+D8 Publikation Nr 140 Jahrbücher der Zentralanstalt für Meteorologie und Geodynamik Amtliche Veröffentlichung, Jahrgang 1929 Neue Folge Band 66 Pp xx+A42+B61+C52+D6 (Wien Gerold und Komp)

Commonwealth Bureau of Census and Statistics, Canberra Official Year Book of the Commonwealth of Australia. No 26, 1933 Prepared by E T McPhee Pp xxxii+942 (Canberra Government Printer) 5s

Istanbuler Forschungen Herausgegeben von der Abteilung Istanbul des Archäologischen Institutes des Deutschen Reiches Band 5 Die Felsbilder von Yazilikaya Neue Aufnahmen der Deutschen Boğazköy Expedition 1931 Zusammengestellt und eingeleitet von Kurt Bittel Pp 12+31 plates (Bamberg) 10 gold marks

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 86 Zoological Results of the Third De Schauensee Siamese Expedition, Part 2 Birds from Siam and the Southern Shan States By Rodolphe Meyer de Schauensee, Pp 165–250 (Philadelphia)

Ceylon Part 4 Education, Science and Art (G) Administration Report of the Acting Marine Biologist for the Year 1933 By A H Malpas Pp 7 (Colombo Government Record Office.) 10 cents

Smithsonian Miscellaneous Collections Vol 89, No 14 Millipeds of the West Indies and Guiana collected by the Allison V Armour Expedition in 1932 By H F Loomis (Publication 3244) Pp ii+69+4 plates (Washington, D C Smithsonian Institution)

Bulletin of the American Museum of Natural History Vol. 67, Article 5 Revision of the Hyrachyidae By Horace Elmer Wood, 2nd. Pp 181–295+plates 20–24 Vol 67, Article 6 Petrology of Stone Artefacts from Mongolia By L Erskine Spock Pp 297–310+plates 25–32 (New York City)

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International Co operation in Science

AT the present time when all nations are faced with many difficult problems in economics as well as in their political relations with one another, they are being compelled to organise their resources to the best advantage and this may lead and in certain cases has led to preferring a nationalised system to the international co operation that many would rather aim at This influence must also be felt by scientific men and may tend to make them visualise the problems with which they deal from a more restricted point of view

On the other hand science itself has been advancing at an ever increasing pace during recent years and this has been largely due to the free and active international co operation which has existed and to the personal relationships which have been formed between scientific men in all countries Not only has this been the case in the exact sciences and in their various applications to the welfare of the community but also it is being widely held that investigations carried out on scientific lines will greatly aid in the solution of many of the problems of the present time Science, which is much more than the mere systematisation of data has done so much to promote international co operation in its own field that it may well encourage a similar spirit in other fields of human activity

International co operation in science it may be granted is generally accepted by scientific workers but it is by no means certain that the fact is equally appreciated by those who are politically in control of world affairs The question must often have arisen therefore whether or not a clear and formal declaration should be made by a responsible body of the principles of co operation between men of all nations which have proved so fruitful for the progress of science

Clearly such a declaration would have to come from a body as widely representative as possible of scientific thought There is not at the present time any scientific organisation which includes all nations of the world, but to the International Council of Scientific Unions which is meeting next month at Brussels some forty countries have already adhered and others can join it at their own desire Moreover the Unions related to it work through about a hundred and thirty national committees in the various countries, which have adhered to one or more of these

Unions in order to promote international co-operation in their particular fields of science

Here then is a large and active international organisation which might with advantage discuss at its forthcoming meeting this problem of international co-operation on wider lines, and in fact the Royal Academy of Sciences in Holland has notified its wish as a member of the International Council to bring this question to the notice of the General Assembly A resolution has been circulated to the countries and the Unions which are members of the Council in which, after expressing the conviction that ultimately a way will be found leading to a more harmonious structure of the world, stress is laid upon the importance of maintaining international co operation in the domain of science in all circumstances While realising that in every country scientific men will be drawn more and more into spheres of national organisation the resolution expresses the hope that they will not lose sight of the international character of science, and will continue to foster the conditions necessary for international co operation since the 'brotherhood' of men of science can be an important factor in attaining the mutual understanding and helpfulness so necessary not only for science but also for all aspects of human endeavour

The International Council cannot dictate a policy to the various Unions, but there is little doubt that the adoption of a resolution on these lines would carry considerable weight Moreover, although the resolution is directed to allied organisations, it is clear from its tone and general content that it is meant to be an appeal to all scientific organisations, and to all scientific workers as well, urging them never to lose faith in the significance of science, pure and applied, for mankind It is to be hoped that the appeal will find a response in every country, whether adhering to the International Council or not, for it is a matter which stands above all political and other divisions The International Council, as the largest existing body representative of international science, is the appropriate body to issue such a declaration, and we trust that it will be given careful consideration If the immediate effect alone would be to induce those countries which are not yet represented upon the International Council to find an opportunity to join in its work, then the resolution might be regarded as a significant step towards the establishment of fuller co-operation among the scientific workers of the world

The Description of Nature

Atomic Theory and the Description of Nature 1 *Four Essays, with an Introductory Survey* By Niels Bohr Pp vi+119 (Cambridge At the University Press, 1934) 6*s* net

It is fitting that the year in which the Bohr theory comes of age should hear a pronouncement by its author on the view of Nature to which it has led It is true that in one sense the pronouncement is not up to date (the book is a reprint of previously published articles, the latest of which first appeared in 1929), but the scant amount of fundamental progress in the last few years, combined with Bohr's remarkable power of always seeing a little ahead of the existing position, makes this of small significance The most striking of the subsequent advances have been the discoveries of the neutron and the positive 'electron , and in the other volume containing a number of later essays on the same subject, in which the general point of view is further developed", which we are promised in the foreword we may hope to find some account of the theoretical aspect of these discoveries In the meantime however, the present volume may be taken as a true representation of the view of Nature afforded by the quantum theory to one of the keenest pairs of eyes in the world of physics

Two of the four essays which, together with an introductory survey, make up the contents of the book are familiar to readers of NATURE, having been published as Supplements in 1925 and 1927 The third essay appeared in German in *Die Naturwissenschaften* in 1929, and the fourth in Danish in *Fysisk Tidsskrift* in the same year The introductory survey also appeared originally in Danish in the Year Book of the University of Copenhagen for 1929 Although, therefore, only a portion (a little less than half) of the material now makes its first direct appeal to English speaking readers, that portion is the latest and, as it happens, the most concerned with the broader aspects of the subject

Bohr's view of the situation created by the quantum theory is well known, and his principle of 'complementarity' is perhaps the clearest expression yet given to the dilemma by which we are faced

"The definition of the state of a physical system, as ordinarily understood, claims the elimination of all external disturbances But in that case, according to the quantum postulate, any observation will be impossible, and, above all, the concepts of

> space and time lose their immediate sense. On the other hand, if in order to make observation possible we permit certain interactions with suitable agencies of measurement, not belonging to the system, an unambiguous definition of the state of the system is naturally no longer possible, and there can be no question of causality in the ordinary sense of the word. The very nature of the quantum theory thus forces us to regard the space-time co-ordination and the claim of causality, the union of which characterises the classical theories, as complementary but exclusive features of the description, symbolising the idealisation of observation and definition respectively."

It thus appears that the classical theories were aiming at a description of Nature which it is impossible to realise, and whenever we have to deal with phenomena in which the quantum of action becomes significant, we must renounce either the concept of space-time or the principle of causality. This does not mean, however, that the essence of Nature as represented by the statement of natural laws is to be regarded as dual. "There can be no question of a quite independent application of the ideas of space and time and of causality. The two views ... are rather to be considered as different attempts at an interpretation of experimental evidence in which the limitation of the classical concepts is expressed in complementary ways."

In such a situation our natural impulse—justified, if justification is necessary, by the success of the special theory of relativity—is to reformulate our ideals so as to make the impossible a thing of no meaning. Just as we escape from the obscurantism of the Michelson-Morley experiment by, fox-like, regarding the grapes of absolute velocity as sour, so we might seek for a point of view from which the concept of space-time or the principle of causality loses all significance. Bohr, however, will not attempt to meet the difficulty in this way. He insists that there can be no escape from a space-time description of experience, space-time being apparently in his view a necessary mode of perception.

> "According to the view of the author, it would be a misconception to believe that the difficulties of the atomic theory may be evaded by eventually replacing the concepts of classical physics by new conceptual forms. Indeed ... the recognition of the limitation of our forms of perception by no means implies that we can dispense with our customary ideas or their direct verbal expressions when reducing our sense impressions to order. No more is it likely that the fundamental concepts of the classical theories will ever become superfluous for the description of physical experience." And again: "It lies in the nature of physical observation, nevertheless, that all experience must ultimately be expressed in terms of classical concepts, neglecting the quantum of action."

With this as a guiding principle there is clearly nothing to do but to accept defeat, and Bohr, who is the incarnation of logic, capitulates unreservedly. "A conscious resignation," he says, is implied in the original quantum postulate, and "we must ... be prepared to find that further advance ... will require a still more extensive renunciation of features which we are accustomed to demand of the space-time mode of description."

It may be a futile rebellion against implacable Fate, but we must confess an unwillingness to submit to this depredation of our philosophical rights. Nor does such an attitude seem entirely Promethean. True, there is no evading the choice which the principle of complementarity imposes on us, but we fail to see that in discarding the possibility of a complete space-time description of Nature we weaken in the least our chance of fulfilling the traditional task of science which, in Bohr's accurate and succinct phrase, "is both to extend the range of our experience and to reduce it to order". We cannot accept the view that the interpretation of experience rests ultimately on the space-time concept. Interpretation is a logical process, and the laws of logic are independent of the concepts which they relate together. If the space-time concept has qualities which unfit it for relating the facts of experience, we must discard it in favour of something more suitable. There is nothing inherently impossible in this: it is simply a matter of cultivating our power of abstraction and expelling deeply rooted prejudices. That space-time is by no means necessary to logical thought is sufficiently evident in the fact that we can reason about such non-spatio-temporal ideas as courage, virtue, desire and a score of others; and although these particular concepts (and, we may add, that of free will) are obviously unsuited to physical applications, their existence justifies belief in the possibility of suitable ones until proof to the contrary is forthcoming. "Il faut vivre," pleaded the Abbé Desfontaines. "Je n'en vois pas la nécessité," replied the Comte d'Argenson. Only the former, we believe, was committed to a renunciation.

To be somewhat more specific, let us consider what is actually involved in the fact that the state of an observed system is altered in an unknown way by the agencies of observation There is an indeterminacy here only if we persist in analysing the observation into a thing observed and a means of observation As Bohr points out, the details of the analysis are arbitrary (we can include part of the observing apparatus in the system if we like), but what is much more vital is the fact that, so far as the ordering of our observations is concerned, the analysis itself is voluntary What we are given in experience is simply an observation—represented by a number Its expression as a relation between an object and a perceiving subject has been (and still is for large scale phenomena) an exceedingly useful one, but no more inevitable than the analysis of motion into an inertial and a disturbed part If we so express it then it is indeed difficult to see how we can make the hypothetical object independent of space and time, and we are forced to submit to the ambiguities of the quantum theory , but this very fact is surely an argument for discarding the analysis

By this simplification we avoid the dilemma so clearly expressed by Bohr in the following passage For describing our mental activity we require, on one hand, an objectively given content to be placed in opposition to a perceiving subject while, on the other hand, as is already implied in such an assertion, no sharp separation between object and subject can be maintained, since the perceiving subject also belongs to our mental content ' A sharp separation however can be maintained—in physics at least the object is experience (or observations) , the subject, reason Reason is never an object of study in physics whatever psychology may do with it, and no overlapping is therefore possible Confusion arises only when we *sub* divide the object, experience into a thing observed and a means of observation, for the quantum theory teaches us that no unambiguous subdivision of this kind can be made To avoid confusion, therefore, we have simply to accept experience as it is

On a very interesting page Bohr discusses an unusual aspect of the space time concept

> One need only remember here the sensation often cited by psychologists, which every one has experienced when attempting to orient himself in a dark room by feeling with a stick When the stick is held loosely, it appears to the sense of touch to be an object When, however, it is held firmly, we lose the sensation that it is a foreign body, and the impression of touch becomes immediately localised at the point where the stick is touching the body under investigation It would scarcely be an exaggeration to maintain, purely from psychological experiences, that the concepts of space and time by their very nature acquire a meaning only because of the possibility of neglecting the interaction with the means of measurement "

It is instructive to consider this passage in connexion with the doctrine that the space time concept is inevitable for the description of Nature If we could make assertions about space and time 'purely from psychological experiences', it is clear that we should have to grant them a sort of inevitability, as Bohr maintains, but a question concerning the use of words arises here The experience described seems to us no more psychological than that of any physical experiment , it is simply derived from a different physical sense—the sense of touch instead of the customary sense of sight The problem which suggests itself (an interesting one) is whether the voluntarily adopted concepts of space and time (so far as they are applicable at all) need to be endowed with the same properties to enable them to correlate tactual as to enable them to correlate visual sensations Physics, however, relies very little on the sense of touch, and the question is therefore of philosophical rather than of practical interest

If, however, we feel that Bohr presents us with a clear statement of a problem rather than its solution—with an appetite rather than a meal—we must not neglect to point out that the renunciation to which we object is accepted by him not merely with fortitude but with enthusiasm We must consider this very renunciation " he says, "as an essential advance in our understanding " 'My purpose has been to give expression to our enthusiasm for the prospects which have been opened up for the whole of science ' This is an attitude possible only to a fearless mind and a noble spirit it is one which we respect and admire, but cannot share HERBERT DINGLE

Mechanised Medicine

Red Medicine Socialized Health in Soviet Russia By Sir Arthur Newsholme and Dr John Adams Kingsbury Pp xi+324+18 plates (London William Heinemann (Medical Books), Ltd , 1934) 10*s* 6*d* net

THIS work is an examination of the conditions of medical practice in Soviet Russia in 1932 Its entertainment value is indubitable and is derived from the description of a five weeks' tour made in the summer of 1932 during which the distinguished authors travelled more than six thousand miles of Soviet Russia They write with a boyish enthusiasm and *naïveté* which gives the book great charm They recognise that in an implacably 'conducted' tour they were shown the best and not the worst

The scientific value of such a tour is, of course, slight Seven days of the short period were spent on steamships on the Volga and Black Sea, and much of the rest of the time in railway travel The real value of the book rests upon the fact that the authors are authorities on their subject and apart from their brief visit, they have steeped themselves in the literature of Russian medicine In fact, the work is to be considered as the coping stone to a considerable series of studies on the relation of private and official practice of medicine carried out in eighteen countries and published in three volumes by the American Milbank Memorial Fund in 1931

As the result of these studies, the authors became convinced medical (though not necessarily political) communists Private medical practice, as carried out in western countries is to them anathema and they passionately desire the cessation of remuneration to the doctor for each medical act They would have all practitioners State servants This being so, the organisation of medical practice in Soviet Russia is naturally much to their liking, and their descriptions of it are frequently the occasion of the shaking of a minatory fist or, at any rate, the wagging of a hortatory finger at the medical customs of the west To emphasise this, the authors, while writing in an enthusiastic manner of all they approve in Russia, studiously avoid discussion of many things of which they clearly disapprove, as this would weaken the effect they wish to produce

In a chapter on public abortion, we learn that any pregnant multiparous woman in Russia can demand, as a right, entry to an institution in which abortion is induced by State doctors, and we are informed that in Moscow in 1929 total abortions were sixty-one per cent in excess of normal births There are chapters on the care of maternity, the care of children and youths and the care of the workers, but in vain does one look for a chapter on the care of the aged, to this no reference is made Amongst the photographs with which the book is lavishly adorned, a picture of a works committee discussing production produces astonishment This is no witenagemot, for the committee consists of young persons scarcely more than children Later, figures are given from which it may be deduced that the average age of a Russian of to-day is about twenty years

The fact appears to be that war, pestilence famine and pogrom have done their work very well In the language of the book, old age has been liquidated' and in Russia we are faced with a population which consists literally, and not merely metaphorically, in children This fundamental fact being ascertained, does it not throw a great illumination on all that is happening in the land? The vital statistics which crowd this book need correction for age distribution and cannot be applied crudely for comparison either with western States or with Tsarist Russia

The authors are amazed at the extent of the provision for the sanatorium treatment of tuberculosis which has been procured by the conversion of nobles' palaces They do not appear to have been struck with amazement by the need for all this provision From figures given, it is clear that there is a tuberculous problem in Soviet Russia of great magnitude The case rate for tubercle per 10,000 of the population is 116 5 and appears to be on the increase In London it is 16 65 It is not necessary to look far to explain this high incidence Rapid industrialisation, bad housing, insufficient food supply, and a juvenile population, contain all the necessary ingredients for the production of an alarmingly high incidence

Although State curative medicine is organised on a vast scale, there is grave doubt not only whether there are sufficient doctors, but also of the efficiency and training of those that exist In this, as in many other respects, quality has been sacrificed to quantity

Of preventive medicine there is little said, which is rather surprising since Sir Arthur Newsholme may be regarded as the Nestor of English sanitarians, but, no doubt, the reasons are first that the matter under consideration is not preventive but curative medicine, and secondly that there is as yet little sanitation to be observed in Russia It is pointed out, however, that the high and continuing incidence of typhoid fever, typhus and dysentery throw a strong light upon the neglect of domestic cleanliness and communal sanitation

The authors deplore the absence of domiciliary medical treatment, but the word "home" contains a bourgeois idea and where there is no *domus* there can be nothing domiciliary

At the conclusion, the authors do allow

themselves one misgiving and this is Can such an order (that is a better social order) in the fullest sense be created which does not include recognition of man s spiritual relation to the divine ? This of course is also a shockingly bourgeois sentiment

Scientifically the case must be judged on biological grounds Soviet Russia is a vast biological experiment Unfortunately our biologists are hopelessly at variance on the very point which would put all doubts at rest and the question is still an open one If Prof MacBride is right the communist governors of Russia are right and we may order our tumbrils If Weismann is right they are wrong and we may sleep quietly in our beds

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Aluminium and Tungsten

Gmelins Handbuch der anorganischen Chemie Achte Auflage Herausgegeben von der Deutschen Chemischen Gesellschaft (1) *System Nummer 35 Aluminium* Teil B Lief 1 Pp 308 48 gold marks (2) *System Nummer 54 Wolfram* Pp xviii+xi+397 64 gold marks (Berlin Verlag Chemie G m b H 1933)

(1) THIS section of Gmelin s Handbuch which has appeared before the publication of Part A deals with the compounds which aluminium forms with the principal non metals (except silicon and phosphorus) No stable hydride of aluminium is yet known the only evidence of its formation being derived from band spectra produced in various ways but R S Richardson has detected it in the sun s envelope

A large part of the volume is devoted to alumina Methods of preparing well formed crystals of the oxide and a list of patent specifications relating to the manufacture of large single crystals which are used as synthetic gems are detailed The two main technical processes used in the purification of alumina from bauxite are given in convenient schematic form Hitherto all attempts to extract alumina from bauxite by means of caustic soda at atmospheric pressure have been unsuccessful One of the most notable achievements in the technology of aluminium is the separation of sodium aluminate into its constituents by mechanical agitation The history of this idea is traced to an observation by Bonsdorff in 1833 In 1859 Le Chatelier suggested the crystallisation of alumina from hot supersaturated solutions but no practical result was attained until 1887 when K J Bayer patented the modern process

In the present process the alkaline liquor is first seeded with crystals of alumina and then mechanically stirred No completely satisfactory explanation of the process has been devised Neither sand glass powder graphite nor colloidal alumina can be substituted for the crystals used for seeding and even crystalline alumina itself is often ineffective The best material for the purpose is the product which crystallises out between 25° and 35 C and a somewhat narrow range of concentrations is also desirable

The preparation of alumina from other compounds is also dealt with very fully and the hydroxide is described under the headings of gels sols and crystals There is a long list of references to the literature on the manufacture of aluminium nitride which is used in the Serpek process for synthesising ammonia Aluminium chloride is also fully described but its use in organic chemistry falls outside the scope of the work

Several organic derivatives are recorded for example aluminium carbide and various salts but not aluminium trimethyl The organic salts of aluminium have attracted less attention than those of many other metals but the acetate is important both in analytical work and in the dyeing industry The records of its stability in hot solutions are somewhat contradictory but the formation of colloidal alumina when a solution of the acetate is boiled appears to have been observed by Gay Lussac in 1810 Aluminium formate acetate and tartrate all give evidence of complex ion formation Thus normal reactions of the metallic ion are suppressed Biot observed so long ago as 1835 that concentrated aqueous solutions of the tartrate were lævorotatory but the pure salt has not yet been isolated with certainty The chemical nature of all these organic salts seems to call for further investigation

(2) The importance of tungsten in modern industry has led to the accumulation of a vast amount of information about the properties and uses of this metal The first reference to it seems to have been made by Ercker in 1574 but until the end of the eighteenth century the word wolfram (with a great variety of spellings) was used to denote the ores of tungsten which are often associated with tin and interfere with the extraction of that metal Scheele first separated the acid oxide in pure form and recognised it as something different from molybdic acid whilst the Spanish brothers de Lhuyart first isolated the metal in 1783 Exact quantitative work on the

lower oxides was undertaken by Berzelius in 1816 but the industrial application of tungsten was delayed until 1847 although an alloy with iron had long been known After the Paris Exhibition in 1900 the use of tungsten in steel manufacture became general and three years later filaments of the metal were used in electric bulbs

Very interesting data are given relating to the production of tungsten Before 1910 Australia was the largest producer in the world then Burma and the United States gained the lead for a few years but since 1918 the greater part of the world s output has come from China In technical research Germany led the way until her supplies were cut off during the War

Tungsten is used as a hardening component of certain alloys and also as a pure metal Carbide of tungsten is an important constituent of the hard alloys and tabulated lists of references to the patent specifications are grouped according to the melting or sintering properties of the alloys Recent industrial applications of the pure metal have been largely due to its low volatility and high melting point It has practically replaced all other metals as lamp filaments and it is used for making electrodes thermo elements and many other appliances This volume is packed with details about the properties of tungsten and its compounds and the literature has been revised to April 1933

Modern Geometry

Analytical Geometry of Three Dimensions By Prof D M Y Sommerville Pp xvi+416 (Cambridge At the University Press 1934) 18s net

THIS is a textbook it is not too difficult for the average honours student it includes the material usually required for examinations yet it also includes less usual subjects such as line geometry cubic and quartic curves cubic surfaces ruled surfaces higher space the Veronese surface the application of matrices invariants and invariant factors above all it conveys something of the true spirit of modern geometry For many years geometrical research has been made both easier and more effective by projective methods and space of more than three dimensions but this had not hitherto found recognition in any sufficiently elementary English textbook

Though primarily algebraical and three-dimensional the book provides a more unified knowledge of geometry by the frequent use of purely geometrical methods and by excursions into one two four and five dimensions It does not deal with birational transformations or topology Its reasoning is in general particularly concise and intelligible though occasionally condensation renders the argument obscure A carefully chosen first course of reading makes it really suitable for those whose knowledge of co ordinate geometry is limited to elementary conics References to more detailed expositions are too scanty

The treatment of the straight line plane and quadric accords with examination requirements but rectangular Cartesians are systematically supplemented by homogeneous co ordinates line co ordinates matrices and (most conspicuously and successfully) the circle at infinity and other projective methods There are useful notes on imaginary elements Beginners may possibly find the projective investigation as an introduction to focal properties somewhat overwhelming The invariants of two quadrics are treated extensively Segre characteristics are sufficiently explained Certain chapters would benefit from a more comprehensive selection of heuristic examples

Elsewhere pure projective geometry tends to predominate In one chapter co ordinates are established without reference to metrical considerations difficulties are avoided by assuming openly the fundamental theorem

The curve theory includes developables the (plane) Plucker relations Luroth s theorem the twisted cubic and its polar system twisted quartics of both species curves upon a quadric A chapter on line geometry deals with the quadric in five dimensions The treatment of surfaces includes curvature polar surfaces the effect of isolated singularities on class ruled surfaces double curves the cubic surface and its twenty seven lines the Steiner surface the Veronese surface normal varieties the cyclide

Misprints are not serious (y) for (x) on p 371, is slightly confusing A few statements require emendation three concurrent lines on a cubic surface do not necessarily meet in a node quartic surfaces are known containing as many as sixty four lines despite Continental nomenclature the general point of a double curve should not be confused with a binode part of 14 683 is incomprehensible Terms are too freely used in an unconventional sense without warning for example linear series (for regulus) self conjugate tetrahedron

The excellence of this work emphasises how much geometry loses by the recent death of its author

Short Reviews

The Physics of Electron Tubes By Dr L R Koller (International Series in Physics) Pp xiii+205 (New York and London McGraw Hill Book Co Inc, 1934) 18s net

ONE of the most useful functions of books or monographs on limited and somewhat specialised branches of scientific knowledge is the summary in a convenient and critical form of all the available information on the subject This function is admirably fulfilled in Dr Koller's monograph which, in the space of some sixty thousand words presents a survey of electron emission and its application to the various types of valves and photoelectric cells in use to day

Beginning with the general theory of thermionics the characteristics of the emission from various types of cathode are described together with practical advice on the construction of such cathodes and their use in electron tubes The deleterious action of gases and the methods for securing their removal are dealt with for the high vacuum type of valve while two chapters are devoted to the gaseous discharge tube the technical applications of which have been so widely developed in recent years In a similar category may be placed the photoelectric cell, the fundamental physics of which are adequately covered The whole book has the merit of not being overloaded with matter which is now more of historical than of fundamental scientific interest In spite of this, however the work gives a sense of completeness in reviewing the whole subject, and the tables of data and lists of references given at the end of each chapter will prove invaluable to the reader whose scientific or practical interest in the subject would necessitate his delving much deeper than is possible within the limits of a single volume The general sense of this notice is thus thoroughly to recommend the book as a scientific and practical introduction to the subject covered by its title The production of the book is excellent

The Annual Register a Review of Public Events at Home and Abroad for the Year 1933 Edited by Dr M Epstein Pp xii+312+184 (London, New York and Toronto Longmans Green and Co, Ltd, 1934) 30s net

THE full summary of the past year's history again appears in this indispensable work of reference Great Britain and the Empire naturally receive most attention and there are full accounts of the efforts in the cause of disarmament, and the hopes of the World Economic Conference Then follow sections on the League of Nations and foreign history, with ample attention to events in Germany and the crisis in the United States The second part of the volume as usual contains a chronicle of events, the year's obituary with admirable short biographies, and retrospects of literature, art, drama, science law and finance Little of importance can be overlooked in these packed reviews of various branches of achievement Science is dealt with in thirteen pages and is a useful record of the year's discoveries and publications A full index completes the volume

Adam's Ancestors an Up to-date Outline of what is known about the Origin of Man By Dr L S B Leakey Pp xix+244+12 plates (London Methuen and Co, Ltd, 1934) 7s 6d net

IT is no detraction from the merits of Dr Leakey's book to say that it does not call for extended notice The alternative would be to devote to controversial matters as much space as the author himself has given to their discussion For his book is not merely an introductory study for the use of the layman—a purpose which it serves admirably—but it has also afforded the author the opportunity of laying before his fellow specialists his views on obscure and controversial matters—such questions for example, as the dating and sequence of Mr Reid Moir's pre palæolithic cultures in East Anglia the relation of the various cultures now distinguished in the early phases of the Old Stone Age, the classification of the deposits of late Tertiary or early Quaternary times and so forth Dr Leakey's views are stated clearly and with due restraint

Handbuch der anorganischen Chemie In 4 Banden Herausgegeben von Prof Dr R Abegg, Dr Fr Auerbach und Dr I Koppel Band 4 *Die Elemente der achten Gruppe des periodischen Systems* Teil 3 *Kobalt und seine Verbindungen* Lief 1 Herausgegeben von Dr I Koppel Pp xvi+626 (Leipzig S Hirzel 1934) 58 gold marks

THIS instalment of Abegg's 'Handbuch" includes sections on the atomic weight of cobalt, the cobalt atom, cobalt metal, cobaltous and cobaltic compounds alloys and compounds of cobalt with metals and metalloids, cobalt ammines, and a final short section on the colloid chemistry of cobalt and its compounds It provides a monumental record of the properties of a very interesting element at a price which makes it more suitable for libraries than for individual purchasers

Aids to Botany By H J Bonham (Students' Aid Series) Pp viii+221 (London Baillière, Tindall and Cox, 1934) 3s 6d

THIS book sets out to provide a revision course in botany for Higher School Certificate candidates and first year university students reading for the intermediate science or pre-medical examinations in the subject The scope of the book, however, is scarcely that of present-day requirements, and in a second edition many of the diagrams should be improved

Tidal Estuaries Forecasting by Model Experiments*

By PROF A H GIBSON

THE earliest work on tidal models was carried out by Osborne Reynolds at the University of Manchester in 1885 on scale models of the Mersey estuary This was followed by an investigation into the general question of the use of such models in which Reynolds co operated with a committee appointed for this purpose by the British Association in 1888 The experiments were devoted mainly to an examination of the behaviour of models of the same hypothetical estuary of symmetrical shape to different scales As a result of this investigation the committee reported in 1891 to the effect that It would seem therefore that by carefully observing certain [stated] pre cautions the method of model investigation may now be applied with confidence to practical problems

Shortly afterwards Vernon Harcourt carried out an investigation on a model of the estuary of the Seine in which the results of improvements made in the estuary since about 1833 are stated to have been reproduced with considerable accuracy Between 1890 and 1926 very few investigations of this kind appear to have been carried out and these for various reasons not with any marked degree of success

Any scale model in which fluid motions are involved must not only be geometrically similar to its original but also the velocities must be so related to corresponding velocities in the original that all corresponding forces are in the same ratio The model and its original are then dynamically similar and all lines of flow and wave formation will be similar The speeds of model and original at which this condition is satisfied are called corresponding speeds

In many hydraulic problems however viscous forces are unimportant compared with those due to inertia and in this case it may be proved that the corresponding speeds are proportional to the square root of corresponding dimensions Thus in ship model tests the corresponding speeds of model and original are proportional to the square root of their respective lengths These speeds give similar wave formations Viscosity the effect of which is relatively small prevents exact similarity of the lines of flow in the immediate vicinity of the vessels at these speeds and this introduces a scalar effect for which a correction can be made

In the case of a tidal model the correct propagation of the tidal wave is an all important factor The velocity of propagation of such a wave is proportional to the square root of the depth of the water through which it travels so that the times required for the wave to traverse corresponding distances in the model and the estuary will be proportional to the horizontal scale ratio and inversely proportional to the square root of the vertical scale ratio This determines the ratio of corresponding times and therefore gives the correct tidal period for the model If for example the horizontal scale ratio is 1 40 000 and the vertical scale ratio is 1 400 the time ratio is 1 2 000 and since the tidal period in Nature is about 12 hours 20 minutes the correct tidal period in the model is 22 2 seconds

If the effects of viscosity are small in comparison with those due to inertia as is the case in a model of suitable size all velocities will then be in the ratio of the square root of corresponding depths

DISTORTION OF SCALE

When constructing a river or estuary model it is seldom possible to adopt the same scale for both horizontal and vertical distances Especially in tidal models the horizontal reduction in scale has usually to be considerable in order to keep the model within reasonable dimensions and a scale of more than 18 in to 1 mile (1 in 3 520) is unusual a more common ratio being about 1 8 000 If this latter scale were also adopted for the vertical depths in a model of an estuary having a tidal range of say 33 ft the range in the model would only be 1/20 in and the current velocities would only be about 1/90 of those in the estuary In such a model the motion of the water would certainly not be turbulent as in the estuary and no motion of the bed materials would be likely to occur To avoid this difficulty the vertical scale ratio is made much less than the horizontal scale ratio Thus by making the vertical scale ratio 1 200 the tidal range in the case mentioned would be 2 in and current velocities would be 1/14 of those in the estuary

Reynolds in his investigations on models of estuaries of simple symmetrical form concluded that for a model to reproduce estuarine conditions the product of the cube of its maximum tidal range measured in feet multiplied by the ratio of the vertical and horizontal scales should not be less than 0 09 and while in an estuary of non symmetrical shape a smaller value of the criterion may be adopted it does give an approximate idea of the scales which are likely to give good results in any particular case

It may be of interest to note that this distortion of scale is usual in Nature small streams flowing through alluvial ground having much steeper side slopes and gradients than large rivers of similar regime in similar ground In a very large river such as the Mississippi the Ganges or the Irawadi the maximum depth will rarely exceed 1 100 of the maximum width while in a small stream in similar ground this ratio will seldom be less than 1 5

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* From a Friday evening discourse delivered at the Royal Institution on April 13

A moderate distortion of scale, either in an estuary or river model, would therefore appear to be rather an advantage than otherwise provided that the side slopes which would be necessary in the model to reproduce those in the estuary do not exceed the natural angle of repose of the bed materials Since this angle is only about 30°, there will usually be points in a model where the sand is unable to stand up to the required slope, and where in consequence, the depth of the channel or the height of the banks will be less than in the estuary The actual slopes in most tidal estuaries are, however, very slight indeed, and experience shows that the areas over which the angle of repose would be exceeded in a model do not usually amount to more than a very small fraction of the whole In such cases, if thought desirable a slight stiffening of the bed material with an admixture of clay will usually enable the required slope to be maintained

BED MATERIALS

A criticism often levelled at the use of tidal and river models is that since the actual bed material is usually a not very coarse sand unless something of the nature of an impalpably fine powder is used in the model, the grain size and textual roughness of the bed will not be reduced in the same proportion as the remainder of the model The idea that the bed material should of necessity be scaled down in size would appear to be based on two misconceptions The first is that the resistance to flow is appreciably affected by the surface roughness Actually, in any model of a large river or estuary having a sandy bed the resistance is almost entirely due to eddy formation caused by curves and irregularities in the sides and by irregularities in the depth, the magnitude and effect of which are overwhelmingly greater than that of a change in the textual roughness of the surface itself

The second misconception is that because the current velocities are reduced in the model, the size of particle which they will move is necessarily correspondingly reduced This overlooks the well known experimental fact that a given mean velocity of flow has a much greater scouring effect in a shallow than in a deep channel

Investigators of the problems of silt and scour in Indian and other rivers and canals have found that rivers and canals of similar cross section but differing in size, and having the same bed materials, are subject to similar scour or siltation if the mean velocity is proportional to d^m, where d is the depth and where the value of m as given by various observers varies from about 0 45 to 0 64 All agree that the value is in the neighbourhood of 0 5, and if it were actually 0 5, two similar channels in the same bed material would scour or silt similarly if their velocities were proportional to the square roots of their depths But this is the ratio of velocities adopted for purely hydrodynamic reasons in tidal models, so that it would appear that materials of approximately the same grain size and density as comprise the moving sand banks in the estuary or river, should logically be used for the model Actually the determination of the best material and grain size is a matter for experiment, that which gives the best coincidence with Nature being the one to be adopted

In some German laboratories, working on problems of one-way river flow, a technique has been developed in which bed material considerably coarser and somewhat less dense than that found in the river is used At the same time the slope of the bed is increased This has been found to prevent the formation of sand ripples, which occur with some combinations of sand and velocity of flow On the other hand, in recent work on models of the Mississippi River at the U S Waterways experimental station at Vicksburg, a sand has been used having a diameter (0 0107 in) about a third of that of the somewhat coarse sand in the river and has been found to give excellent agreement with observations in the river itself

THE SILT PROBLEM

Many estuaries carry a considerable amount of silt of a colloidal nature in suspension This is originally brought down by the rivers feeding the estuary It tends to coagulate and to be deposited, forming silt banks especially where the fresh river water meets the saline water from the sea, and in a model of any silty estuary this effect needs to be reproduced

An examination of samples of the river waters enables the proportion of silt carried in by these to be determined, and the introduction of this proportion in the river water supplied to the model does not present any great difficulty In order to ensure that this shall tend to be deposited at the same place in the model as in the estuary, it is necessary to reproduce, in the correct ratio, the coagulating effects of the sea water The matter is somewhat complicated by the fact that, while the ratio of the distances through which a given particle has to sink through corresponding depths equals h/H, the corresponding times in which this is to take place are in the ratio $\frac{l}{L} \sqrt{\frac{H}{h}}$ It follows that the actual rate of fall of a particle in the model should be greater than that in the estuary in the ratio $\frac{h}{H} \frac{L}{l} \sqrt{\frac{h}{H}} = \frac{L}{l}\left(\frac{h}{H}\right)^{3/2}$ This greater rate of fall can be produced by increasing the size of the particles, either by using silt of greater coarseness, or by using some coagulating medium more effective than the salts in sea water In the various models I have constructed, the colloidal silt from the estuary itself has always been used, and alum solution has been used as the coagulating medium, experiments having been carried out in each case to determine the exact degree of concentration of this solution required to give the correct rate of deposition in the model

SEVERN MODEL

In 1926, the Severn Barrage Committee of what was then the Department of Civil Research decided that the only way to investigate the probable effect of a proposed tidal power barrage across the Severn estuary was to construct a working scale model Such a model, to a horizontal scale of 1 8 500 and a vertical scale of 1 200, was made in the Engineering Laboratories at the University of Manchester

The information required from the model was (1) The effect of the barrage on the tidal levels above and below its site, at all points between Barry and Gloucester (2) The effect on the tidal currents (3) The effect on the configuration of the sand banks and especially of the navigable channels (4) The effect on siltation above and below the barrage (5) The effect on sewage disposal (6) The effect on flooding in times of flood discharge from the rivers entering the estuary

The available data comprised details of a survey of the upper estuary carried out by Capt Beechey in 1849, along with Admiralty charts of the lower estuary of about the same period and some tidal observations from Penarth and Avonmouth and a few points in the upper estuary

These were supplemented in 1927 by the Hydrographic Department of the Admiralty, which took samples of the water at various points in the estuary, from which the salinity and silt contents were determined, samples of the bed materials, additional tide curves, float and current observations, observations on the Severn bore and, finally, a detailed survey of a large part of the estuary above and including the site of the barrage This in conjunction with Admiralty charts of the lower estuary, enabled the general configuration of the estuary at two times approximately seventy eight years apart to be compared, and these two surveys were used as a basis of calibration of the model

In the first place, the bed of the model was moulded in sand to the 1927 survey, after which a series of tidal observations were made at its seaward end, at the point corresponding to Penarth The mechanism and the form of the plunger producing the tides were adjusted by successive trial and error until the correct tidal curves were obtained at the seaward end of the model As the tidal wave advances up the estuary, considerable changes take place in its height and form, and a comparison with observations in the estuary shows that these changes are closely reproduced in the model

A comparison of the distances travelled by floats dropped at corresponding points in the estuary and model also shows a very close agreement, while the behaviour of the Severn bore, which was well developed in the model, shows an almost uncanny agreement, both as regards its height and rate of travel, with the behaviour of the original as determined by the Admiralty Survey party

After having obtained the correct tides, tests were carried out to determine the best bed material Twelve materials were tested in all, ranging from powdered pumice on one hand to emery on the other In each case the bed was moulded to the Beechey survey of 1849 and was surveyed after the number of tides (55,200) required to bring the date to 1927 The material which gave the closest agreement with the estuary survey of 1927 was found to be a silica sand about 25 per cent finer in grain than the sand in the estuary, and this was then used for all further work With this particular sand a comparison of the configuration of the model and of the estuary at the end of the period showed a good general agreement, especially in that part above the site of the barrage The general agreement, in fact was such as to indicate that when modified by the introduction of the barrage, the effect of this in the estuary might be expected to be very similar to that in the model

The tests to determine the effect of the barrage are carried out in pairs In the first of each, the bed of the estuary is moulded to represent the 1927 contours and a test is carried out without the barrage, surveys being taken at the end of each 10 20, 30, years The bed is then remoulded to the original state, and the test is repeated with the barrage installed and in operation, surveys being taken at the same intervals of time as before The complete results of these experiments have been embodied in an appendix to the report of the Severn Barrage Committee of the Economic Advisory Council

GENERAL REMARKS

The successful use of a tidal model depends largely on its being of a suitable scale, and on the possibility of being able to reproduce with reasonable accuracy the physical factors tending to produce movement of the bed materials As regards the scale, the largest scale which the available space permits is advisable This is partly because the necessary distortion of scale becomes less as the scale is increased and partly because it enables details to be developed and studied more accurately

Much also depends on the conformation of the estuary and on the tidal range, but for the average estuary, for investigating the effect on the navigable channels, the horizontal scale should not be less than about 9 in to the mile (1 7,040) With a tidal range of 30 ft, the Reynolds' criterion in such a model will be satisfied if the vertical scale is about 1 214, giving a vertical exaggeration of scale of 33 1 If circumstances permitted of a horizontal scale of 18 in to 1 mile, the vertical scale could be 180 1, which would reduce the exaggeration to 19 6 to 1 and obviously increase the usefulness of the model

As regards the factors tending to produce movement of the bed material, the one factor which is continuously in operation is the scour of the tidal currents, and these can be reproduced with sufficient accuracy in a model The currents, especially in the riverine part of the estuary are modified by seasonal changes in the river flow, and this factor can also be reproduced, given a knowledge of the probable magnitude and sequence of floods and dry periods. Where the estuary is exposed to some prevailing wind, the action of this can also be reproduced by means of fans adjusted so as to produce surface waves of the required height.

One factor which cannot be reproduced is the effect of violent gales, the incidence of which, both as regards time and direction, is casual. It is true that over a long period, where there is no prevailing gale direction, the effects of such extraneous forces may be expected partially to counteract each other; but on the other hand one such gale may produce changes in an exposed estuary greater than would occur in months or even years of normal ebb and flow.

For this reason, close agreement between model and estuary over a definite period of years is scarcely to be anticipated. Close agreement can only be expected where the estuary is comparatively sheltered and where the effect of the ebb and flow currents is all important. For this reason, a model is likely to be more successful of an estuary in which the physical features are such as to give rise to well defined currents, and in which the tidal range is large so that the strength of these currents is also large. From this point of view the upper Severn estuary, with its 40 ft. tidal range and current velocities approximating 10 knots at places, is an almost ideal subject for model investigation.

Another difficulty in attempting to reproduce all the changes in an estuary over a long period of time is that of reproducing coastal erosion. In many cases this is comparatively small in Nature, but where it is large the difficulties of finding a material which will erode at approximately the correct rate are great. Where this is necessary, it can only be done by extended experiment. In spite of the difficulty, however, experiments now in progress on a model of the Rangoon estuary (by Sir Alexander Gibb at University College, London) show that it is possible to reproduce this effect. This model, in which the effects of coastal erosion and of the monsoon gales have been incorporated, represents probably the most remarkable investigation of this type yet attempted.

Generally speaking, the great usefulness of an estuary or river model lies in its power to indicate the probable effect of artificial changes such as may be produced by the introduction of a barrage, or training walls or bridge piers. Such changes affect the tides and the set and velocity of the currents to an extent and in a manner which is reproduced with close accuracy in a model. In so much as an increased velocity causes scour and a reduced velocity causes deposition, if the bed material is moved the movement caused by the change will be in the same direction and of the same general kind as in Nature, and experience shows that in favourable circumstances good general agreement, both quantitative and qualitative, can be obtained.

Some estuaries owing to their physical characteristics are not suitable subjects for model investigation, but at the worst such an investigation gives information as to the changes in the velocities and directions of the currents, from which valuable deductions as to the probable effects on the bed may be made.

South African Plants Poisonous to Stock

THE subject of plants poisonous to cattle is of perennial interest to pastoralists which is receiving in South Africa the scientific attention it needs. The Veterinary Services and Animal Industry Branch of the Department of Agriculture of the Union of South Africa now has a team of workers (Onderstepoort Veterinary Research Station) consisting of Drs. Steyn and Quin, veterinary research officers, Dr. Claude Rimington, chemist working as a research fellow under the Empire Marketing Board and Dr. A. C. Leeman, botanist attached to the Division of Plant Industry, Pretoria. The first two numbers of the *Onderstepoort Journal*, which is to be issued quarterly in continuation of the annual reports of the Station, contain several interesting papers on the subject.

In a series of six papers in the first issue, Dr. Steyn deals on broad lines with poisonous plants. It is shown that it is possible to develop in animals a considerable degree of tolerance to certain poisonous plants by feeding them with small, but increasing, quantities, whilst with other plants continued ingestion of small quantities may even cause sensitisation or produce cumulative effects. An interesting side issue is the proposal to use sodium chlorate as a weed killer for the rag worts (*Senecio* spp.), which are responsible for poisoning stock both in New Zealand and South Africa. Before adopting it, its toxicity to stock has been carefully tested and found so low that it is regarded as a safe means of destroying these weeds.

It is still uncertain whether the disease known as 'lathyrism', common in certain parts of India, is due to use of *Lathyrus sativus* peas as a foodstuff, and for that reason a proposal to use *L. sativus* hay as a feeding-stuff in South Africa has been investigated. The hay proved innocuous to rabbits, sheep and cattle even when fed in comparatively large amounts, but was poisonous to horses. Great care was taken to make sure that the hay was entirely derived from *Lathyrus sativus*, and these observations support the view that this plant is the cause of 'lathyrism', and that horses are particularly susceptible to its action.

These studies are continued in the second number of the *Journal* where Drs Rimington and Steyn produce an interesting study of the poisoning of Angora goats suspected to be due to *Psilocaulon absimile* This plant contains malic tartaric and oxalic acids the last mentioned being present to the extent of 8 6 per cent which may therefore well be the toxic constituent concerned On this point however the authors say they have evidence of the presence of a second toxic substance on which a further communication will be presented in due course Six papers entitled Studies on Photosensitisation by Dr Quin have arisen from an attempt to ascertain the cause of geeldikkop a disease of small stock characterised by photosensitisation and by a generalised icterus The disease has been generally associated with ingestion of *Tribulus* spp but it is pointed out that there are well authenticated cases in which *Tribulus* cannot be the cause In view of the occurrence of photosensitisation in geeldikkop a number of fluorescent substances such as eosin erythrosin acriflavin and quinine were administered to sheep but though these all caused photosensitisation in no instance was icterus produced

The association of *Tribulus* with this disease has naturally led to a chemical examination of plants of this genus Already in 1928 Dr Quin had found that administration of the expressed juice of *Tribulus* to sheep caused death the chief symptoms being discoloration of the conjunctivæ the blood vessels having a chocolate brown colour Examination of the blood indicated the presence of an abnormal pigment suspected to be methæmoglobin These observations have been confirmed and Drs Rimington and Quin now show that the lethal factor is potassium nitrite which is only present in traces in the plant but is produced when the ground plant is placed in water by the action of an oxidation reduction enzyme system similar to that present in the potato on nitrates which may occur in considerable quantity in the plant These interesting observations however leave the association of *Tribulus* with geeldikkop unexplained since as Dr Quin points out in a subsequent paper no fresh or dried *Tribulus* material dispatched to the Onderstepoort laboratory or cultivated there has produced a case of true geeldikkop on administration to sheep although several species of *Tribulus* can definitely be held responsible for outbreaks of the disease in the Karroo areas of Cape Province (see also NATURE 132 178 July 29 1933)

Two species of *Hypericum* a genus associated with the production of photosensitisation in animals in Europe have also been examined and found to produce this effect but unaccompanied by icterus *Lopholæna coriifolia* a plant suspected as a possible cause of one outbreak of geeldikkop was found to contain an active substance producing marked fatty changes in the liver but in no way characteristic of the conditions found in geeldikkop Two species of *Lippia* however did produce both icterus and photosensitisation but the symptoms were much less severe than those seen in true geeldikkop Although a final explanation of the cause of this mysterious disease is still to be sought it is clear that progress is being made and incidentally a number of interesting observations on plant chemistry and on the effects of minor plant constituents on animals are being accumulated

Obituary

PROF W M DAVIS

EVERY active worker in geology in geography and in oceanography will feel that the death on February 5 of William Morris Davis at the age of eighty four years is the passing away of a historical figure in science His life when written will be the story of the development of geomorphology and of the creation of an American school of international prestige His whole career more than sixty years of active scientific work exhibits the regular series of interests of many great investigators detailed studies in a relatively limited scientific field next broader applications supported by intense varied and enthusiastic studies to test and support the same—and finally the close of life devoted to a single line of investigation often the ploughing of a lonely furrow

Davis s first field was the southern part of New England including New Jersey and his publications extend to every type of its topography About 1880 he concentrated on the Hudson and Connecticut valleys These lie in a region of tilted blocks produced by faulting the initial fault scarps subjected to extensive erosion As Davis showed the cliffing may be completely altered and these cliffs were termed *fault line scarps* He was fascinated by these studies of erosion and he summarised his many publications in The Rivers and Valleys of Pennsylvania and The Rivers of Northern New Jersey He pictured the work of unchecked erosion on the land by weathering and by water in all its stages finally culminating in a reduction of sea level the *base level* towards which the land surface constantly approaches but which it can never reach’ Here he encountered the established views in respect to marine abrasion and he characteristically set to work on investigations in Europe Asia and South Africa to establish the validity of his views He also studied glacial (recent and Permian) erosion faulting and shorelines with a certain disregard of local researches His work on shoreline topography the continental slopes and marine shelves bristles with original ideas but the soundings on which he was depending were occasionally woefully inaccurate though I cannot recall that these were such as to invalidate his conclusions as to embayed shorelines It will be interesting to mention that in a letter I received more than twenty five years ago he discussed the down faulting of a former extension of the Deccan in the area now occupied by the Indian Ocean, the area of the investigations of the "John Murray Expedition"

It is impossible to refer in any detail to the gigantic output of Davis in these thirty years In his own continent he found every type of country, from completely desiccated to extreme moistness, almost tropical heat to perpetual cold, and he studied the phenomena in respect to each, thus gradually building up that study of the visible earth forms on which modern geography is so largely based He claimed none of his conceptions as new but he looked at every phenomenon through new glasses, and he codified all phenomena to form almost a new science During all these years Davis was teaching not only in his own University, Harvard but also lecturing almost everywhere he was asked His exposition was clear and he used every possible device, particularly solid and composite sections, to make his views clear to his auditors and subsequent readers dismissing all possible opposition, and sometimes ignoring the evidence on which it was based His scientific opponents could not approve where, as in science, views are nicely weighed in the balance, but undoubtedly he gained an immense following in America and stimulated both teachers and the public to observe By many he was regarded as an inspired teacher, but his methods were of more use in popularising science rather than in stimulating research His popular works on geography deservedly secured an immense circulation for the visible world was therein a connected system, made clear by pictorial methods largely original Davis came at the right time

Davis's third period commenced about 1912 when he began to feel a mighty interest in the coral reef problem, upon which he published more than forty papers, actively pursuing the subject until his death He thoroughly enjoyed the subject, for it became necessary for him to travel extensively, and he saw many new faces and met many new types of mind He visited the West Indies several times, with longer expeditions to Fiji and New Caledonia, with calls upon the Great Barrier Reef, Tahiti, and many other places While he criticised Agassiz for the shortness of his visits, and his lack of detailed examination, his methods were much the same, and every locality had to fall into his line He paid little attention to animals and plants and their dependence on the favourable conditions of their environment He seemed to love to indite fierce letters in which he was entirely unsparing of his opponents' feelings, but, when, very occasionally, he wrote a letter in his own hand about himself, he revealed a personality happy in spite of great griefs, a man to be loved Shaler he held in great affection and it gave him joy to write "The Coral Reef Problem", 1928, in the Shaler Memorial Series, a book of value for all time, with its full discussion of embayed shores and unconformable contacts He felt himself inspired Did not he, Dana and Darwin all share the same natal day in different years—and must they not be right ? What was the use of further expeditions when all seemed to Davis so clear ? Why in his necessary travels did the present writer sit down for months on *five occasions* to look at separate reefs ? "A waste of time !" Davis was very human, he deemed it his duty to fight here to gain a great peace hereafter J S G

PROF R CHODAT

GENEVA, which has always had a great name as a school of botany, has suffered a great loss by the death on April 29 of Prof Robert Chodat at the age of sixty nine years A worthy follower of de Saussure and de Candolle, Chodat upheld the traditions of his predecessors by the wide outlook of his botanical studies, and the thoroughness of his investigations

Appointed to the professorship in Geneva in 1891 after studying in Basle and Geneva, Chodat has been responsible during the past forty three years for the development of a first rate laboratory, herbarium and botanical library The lack of university botanical gardens, which he frequently deplored, necessitated his researches being centred in the laboratory, and here he elaborated those methods of pure cultures of Algæ which led to such important results His book on the polymorphism of the Algæ put him at once in the front rank of algologists and stimulated many workers to embark on this line of research More recently he had taken up mycological investigations, and his sound knowledge of physiological chemistry enabled him to advance considerably our knowledge of fermentative processes

Chodat did not, however, confine himself to investigations in the laboratory A visit to Paraguay in 1914 enabled him to study the structure and habits of its plants and resulted in the publication of an important flora of that country Repeated visits to Spain and Portugal and the Balearic Islands with his students gave him a comprehensive knowledge of the Mediterranean flora, of which he published some interesting accounts

Chodat rescued from neglect the Alpine Garden at Bourg St Pierre by attaching it to the University of Geneva, and the vacation courses he gave there every summer attracted many students from England and elsewhere, numerous investigations carried out there were published by the Botanical Society of Geneva Chodat, like other Swiss botanists, was greatly impressed by the numerous Mediterranean plants found in the upper Rhone valley of Switzerland, and his careful observations led him to the conclusion that many, if not most, of them had been distributed from the south across the mountain passes and had not, as was formerly supposed, immigrated by way of the Lake of Geneva

Chodat was a good systematist, as is shown by his monograph of the Polygalaceæ but the wideness of his interests is attested by his publications on fossil plants and genetics as well His wide and philosophic outlook is mirrored in his excellent 'Principes de Botanique", which is in every way an admirable textbook A stimulating teacher, Chodat trained many first rate botanists whose researches do credit to their master So eminent a botanist was sure to receive due recognition abroad, and Chodat was awarded honorary degrees by the universities both of Manchester and of Cambridge, and last year he was awarded the Linnean Medal of the Linnean Society of London, of which he had been a foreign member since 1914 Unfortunately during the last few years, partly due to systematic overwork, he suffered from ill-health, and shortly after his return from a visit to Egypt and Palestine he died after a short illness He will be greatly missed in England, as well as Switzerland, for he was a frequent and welcome visitor to this country, where he had many friends F E W

WE regret to announce the following deaths

Dr M G Foster son of Sir Michael Foster and author of numerous papers on balneology and climatology, on June 16 aged sixty nine years

Dr C E Grunsky, consulting engineer, president of the California Academy of Science, president in 1924 of the American Society of Civil Engineers, an authority on water engineering and supply, on June 9, aged seventy nine years

Prof Thomas H Macbride, emeritus president of Iowa State University, professor of botany in the University in 1884–1914 an authority on Myxomycetes on March 27, aged eighty six years

News and Views

Sir Robert Mond

THE honorary degree of LL D was conferred by the University of Toronto, on June 6 at the time of the annual Convocation, on Sir Robert Mond Sir Robert who was knighted in 1932, is the eldest son of the late Dr Ludwig Mond F R S and has inherited his distinguished father's scientific tastes, as is shown by his association with many learned societies, including the Faraday Society of which he is a past president Another side of his scientific activity is shown by his interest in archæological studies and he is president of the Egypt Exploration Society Sir Robert was one of those chosen to receive an honorary degree at the opening of the new wing of the Royal Ontario Museum in the autumn of 1933, but was unable to visit Toronto until the recent Convocation The Royal Ontario Museum owes Sir Robert a great debt of gratitude, not only for actual gifts of great value, but also for his constant advice during the development of the Museum from very small beginnings His most recent gift is in sharing with Dr Sigmund Samuel, of Toronto, and Bishop White, formerly of Honan, China, now professor of Chinese literature in the University of Toronto, in the donation of a very valuable library of Chinese books, now known as the Chinese Library of the University of Toronto, and containing more than forty thousand volumes

Excavations at Tell el Duweir, 1933-34

AN exhibition of the material discovered by the Wellcome Archæological Research Expedition to the Near East in the second season's excavation at Tell Duweir, 25 miles south west of Jerusalem, under the direction of Mr J L Starkey, will be held at the rooms of the Palestine Exploration Fund, 2 Hinde St, W 1, on July 2–21 The work of the Expedition during the past season has now established the extent of the Early Copper Age site as covering at least 150 acres It includes the remains of a large dolmen The upper terrace of a limestone ridge flanking the Tell across the western valley was found to be honeycombed with caverns which had been artificially enlarged and adapted as dwellings in the Early Copper Age and re used at a later date as burial places Metal here occurred rarely but unique for this early period was a heavy gold bead contemporary with proto early dynastic age in Egypt Rough castings from moulds were found on the surface Pottery was hand made, and small pottery bowls showing a sharp impress afforded evidence of textiles A large necropolis lower down the side of the ridge yielded contracted burials in small oval chamber tombs with a shallow shaft In these were daggers or darts food vessels etc This cemetery is equated with the Egyptian Old Kingdom At the north west corner of the Tell, the Hyksos fosse and revetment were uncovered, and the later system of defence was traced in its entirety The Persian residency superimposed on the Jewish palace fort destroyed in the sixth century B C was cleared

AMONG other discoveries by far the most interesting and important was that of a small temple found in clearing the fosse This consisted of a square sanctuary containing an altar and shrine, with two small store chambers Free standing benches were arranged on three sides of the sanctuary This building had been destroyed by fire and its contents were thus found complete, although damaged by the flames They consisted of a large number of ceremonial vessels and utensils, toilet articles, etc The most important is the painted pot, of which the inscription has already given rise to much discussion among experts, as to the affinities of the script and its translation Other exhibits from the temple include a number of scarabs bearing the name of Amenhotep III, notably one recording the killing of 102 lions in the tenth year of his reign. Ivory, glass and faience objects include a beautiful small ivory mask. The art of this and other carved objects, including a carved hand, three-quarter life size, suggest an artistic relation of some kind with Tell Amarna. Some ivories, much calcined by fire, including a remarkable perfume vase fashioned from an ivory tusk, are delicate examples of the engraver's art. A plaque of Rameses II points to the destruction of the temple having taken place not later than 1262 B.C., but until the levels below the temple have been examined, it is not possible to suggest the date of its foundation.

Fuel Research in Great Britain

In the course of a normal year, about six hundred visitors are received at the Fuel Research Station, Greenwich, but the Fuel Research Board has come to the conclusion that, in addition, a general visitation would be a valuable means of bringing the Station's work before industry and the public. The first visitation was held on June 25, when about three hundred guests were received by Sir Harold Hartley (chairman of the Fuel Research Board), Dr. F. S. Sinnatt (Director of Fuel Research) and Sir Frank Smith (secretary of the Department of Scientific and Industrial Research). The visitors were given an opportunity of seeing practically all the modern methods in the study and treatment of coal. Demonstrations of coal washing, by wet and dry systems, attracted a large number of visitors. A rotary coal dryer and mill for pulverising, together with such burners as the Grid and Vortex for the powdered fuel, were shown in operation. Coal-oil suspensions showed one line along which research is being conducted with the view of making coal a more flexible fuel. Specimens of the liquid products of low temperature carbonisation were shown. But perhaps the focus of interest for most visitors was in the hydrogenation building, where compressors for delivering hydrogen at a pressure of 200 atmospheres, and the converters in which the reaction takes place at that pressure and a temperature of 480° C., were demonstrated in action.

Foot-and-Mouth Disease

Some interesting information was given by the Minister of Agriculture in the House of Commons on June 25, when Sir Arnold Wilson asked two questions on the subject of foot and mouth disease at the request of the Parliamentary Science Committee. Sir Arnold asked what progress has been made by the Foot and Mouth Disease Research Committee during the last two years, and what, broadly speaking, the results of its investigations have been, more particularly in the direction of preventive treatment by inoculation. Mr. Elliot promised a memorandum on the subject in reply and stated that the Fifth Progress Report of the Committee is in course of preparation, and is expected to be available in the autumn. Sir Arnold also asked whether the Committee has considered the possible connexion between the quality of the food of cattle and the incidence of this disease, and whether the Committee is dealing with the question of the prevention of foot and mouth disease by a combination of high quality food and improved hygiene. Mr. Elliot in his reply stated that the Committee has advised that there is "no evidence to show that diet or hygiene, or a combination of both, have any influence on the spread of foot and mouth disease. Clinical observations and experimental work carried out by the Committee have in fact shown that animals in very good condition may contract the disease in a more severe form than animals in poor condition." Referring to the possible spread of foot and mouth disease by imported straw, in answer to a question by Col. Acland Troyte, Mr. Elliot stated that the importation into Great Britain from countries where foot and mouth disease exists of hay and straw for use as fodder or litter for animals is prohibited, and imported straw used for packing merchandise has to be destroyed after use; there does not appear to be justification for further prohibition of the importation of this material.

Educational Sound Films

Under the auspices of the British Film Institute, 4, Great Russell Street, London, W.C.1, a private demonstration of educational sound films was presented at the Academy Cinema, London, on June 21 before teachers and educationists. As Mr. H. Ramsbotham, M.P., Parliamentary Secretary to the Board of Education, pointed out in his introductory address, such films must not be accepted without reservation, for they should always be looked upon as being supplementary to the teacher himself. The production of the films shown was a piece of pioneer work and experimental in character, and the venture augurs well for the future of the cinematograph in education, especially if the producers receive the constructive criticism from teachers for which they ask. There is little doubt that, provided it is not abused, the sound film will prove an important asset to the teacher of the future. The seven films presented on this occasion clearly showed not only the expert film producers we have at our command, but also where the film will be a useful aid and where it will prove an unwelcome intruder.

The films of the life history of the thistle, the growth and irritability of roots, and the physiology of breathing were examples of good educational films—useful tools in the hands of a responsible teacher. They showed the value of the cinematograph film in photomicrography and in demonstrating those types of motion too slow to be watched normally. The film of wheatlands in East Anglia, too, was a good lesson in economic geography and rural science, and demonstrated the possibilities of the film in transporting a class to the actual scene of action, which otherwise has to be done, rather inefficiently, by laborious verbal teaching and much reading. Such films indicate the lines along which it is to be hoped the cinematograph in education will develop. On the other hand, certain films shown depicted the dangers inherent in the cinematograph as a teaching factor That on kitchencraft, for example, merely illustrated the processes involved in making a pork pie Most domestic science teachers, we think, would prefer their pupils to learn such a lesson by doing it themselves But this is only the experimental stage, and though there is much to learn, a great deal of good work has already been done To add to their value, the films are produced under authoritative direction The films shown were made by Gaumont British Instructional, Ltd, 12 D'Arblay Street, Oxford Street, W 1, who are to be congratulated on the excellent production, beautiful photography and useful running commentary The whole performance will be presented later in provincial towns

Repton School Science Society

THE Repton School Science Society held its triennial conversazione in the Science School on June 22–23 when some fifty demonstrations and exhibits in biology, chemistry, and physics were shown by members of the Society In the biology section a demonstration of the circulation of the blood in the tail of a tadpole was shown both the pulse and the corpuscles being clearly visible The laboratory aquarium and numerous specimens collected by the members were also shown Two points of interest in the chemistry section were a demonstration of the spinning, bleaching, and souring of rayon by a home made model, and a set of experiments on testing the hardness of water and the various methods of water softening Perhaps the most conspicuous feature of the physics section was a lecture on the electric spark, which included an elementary account of the mechanism of the spark, illustrated by various experiments on ionisation The conversazione was well attended, and the visitors were impressed by the able manner in which the lectures and demonstrations were given

Architects' Unemployment Committee's Exhibition

A NATIONAL crisis must naturally affect immediately those fields of activity most removed from the provision of essential necessities, and at the close of 1931 architects felt very severely the curtailment of their work due to restrictions required by economy The Royal Institute of British Architects, in this emergency, set up a relief scheme in the form of payment for useful work of a public character made possible by subscriptions to a relief fund started by this and other kindred institutions A sum of nearly £12,000 was collected the whole of which has been expended in salaries and incidental costs in making surveys which should be of considerable value The results are displayed on maps and models now on exhibition at 7, Bedford Square, London Here on the 25 in ordnance map may be seen indicated by colours the disposition of public, commercial and industrial buildings, business premises, and private and municipal housing over the whole of the London district and much of Kent A 6 in map shows London factories, shops, clubs, banks, and public buildings A survey of the heights of London buildings has also been made and recorded An interesting model of the London area is displayed showing the growth of London by centuries from Roman times to the present day The information which can be grasped from the exhibition at a glance is most striking and the maps should be of great value to Government and municipal departments The display suffers from inadequate space, and though ingeniously arranged on curved surfaces, a comparison of the Hampton Court area on the walls with Greenford on the ceiling at some distance is not easy The exhibition was opened by Lord Snell on June 22

Leadership in Industry

IN the Mather Lecture of the Textile Institute delivered on May 25, Mr A P Young (*J Text Inst*, May) gives a stimulating discussion of the functions and opportunities of industrial leadership Reviewing the origin of the scientific era and the imperative necessity for adequate leadership in this age of power production, he sees in it the opportunity for many of the inspired qualities and the spirit of adventure which have animated previous pioneers of creative thought Such leadership should be capable of harnessing to the task of industrial evolution, world co operation and reconstruction the increasing productivity of the human unit, the accelerated rate at which raw materials are brought into service the development of the electrical power era the diminution of the time lag between discovery and industrial application, the linking of production and distribution This must be done on a basis of planned co operation and leadership will function largely through its ability to stimulate the essential spirit of team work

MR YOUNG discusses the qualities required in the industrial leader of this calibre among which he lists this ability to foster team work, creative imagination intellectual sincerity and moral courage, power to co operate with others, knowledge of administrative principles capacity for delegating authority and scientific and technical knowledge He emphasises the importance of a science as well as an art of management and asserts that education for management is one of our greatest national needs, the need extending to the training of foremen and supervisors as well as managers and leaders carrying high responsibilities Mr Young discusses in some detail the problems of planning and leadership in the textile industry laying stress on the service motive in industry He sees a great future for the textile industry when planned and led along such lines, and concludes with a plea for co ordination of the activity of the five research associations which now exist and for a five fold expansion of the industry's expenditure on research within the next five years

A Photographic Centenary

ON June 23, a gathering took place at Laycock Abbey, Wiltshire, to do honour to Henry Fox Talbot, who in 1834 in that house first succeeded in producing photographic impressions on paper Fox Talbot, who was born in 1800 and died in 1877, graduated at Cambridge in 1821, and became known for his original papers on mathematics, physics and astronomy In 1831 he was elected a fellow of the Royal Society and two years later became M P for Chippenham His experiments of 1834 were the outcome of an idea which had occurred to him when sketching the scenery of Lake Como with the aid of Wollaston's camera lucida, and they resulted in the development of Talbot's first process, photogenic drawing, described to the Royal Institution by Faraday in January 1839 The guests at Laycock Abbey on June 23 were received by Miss M T Talbot, the inventor's granddaughter, and an address on Fox Talbot's personality was given by his grand son, Prebendary W G Clark Maxwell Other addresses were given by Mr H Lambert, of Bath, and Mr A J Bull, president of the Royal Photo graphic Society A large exhibition of Fox Talbot's early apparatus and of his negatives and prints was arranged in the gallery and among these was prob ably the earliest existing photograph a window in Laycock Abbey

Blériot's Flight Across the English Channel

To commemorate the first flight by aeroplane across the English Channel by M Louis Blériot on July 25, 1909, twenty five years ago, a demonstra tion took place at his aerodrome at Buc near Paris on June 23 which was attended by the President of the French Republic, M Lebrun, Lord London derry and Sir George Clerk, the British Ambassador The old Anzani engined monoplane in which the flight was made was on exhibition, and in the fly past which closed the meeting modern French aircraft scattered flowers upon it At the time of the flight M Blériot was suffering from injuries to his foot and the crutches which he was using were strapped inside the fuselage During the afternoon, many displays took part in which a squadron of Hawker Fury fighters of the Royal Air Force joined and in a speech Lord Londonderry said that M Blériot found a new high road of the air, which, within the short period of six years from the first flight, was to be traversed, not by a single Englishman paying a return visit to the coast of France, but by British pilots in their thousands, flying to the help and defence of Louis Blériot's fellow countrymen

Recent Acquisitions at the Natural History Museum

An important donation to the Zoological Depart ment of the British Museum (Natural History) is a gift from the Rowland Ward Trustees of a mounted head of a female addax (*Addax nasomaculatus*) from the Sudan An abnormal elephant tusk from Uganda has been presented by Mr George Howard, of the Queen's Bays This tusk is of interest as showing an early stage in the formation of the so called 'four tusked elephant' Another donation of interest is that of three skulls of the so called dwarf elephant from the Gola Forest in Sierra Leone, the gift of Sir Arnold Hodson, the Governor of Sierra Leone These specimens would seem to substantiate the theory that this animal, known locally as the 'Sumbi', is merely the young phase of what has been termed the 'forest' elephant, which may be known by the name *Elephas africanus cyclotis* There has been presented to the Department of Geology a large and valuable collection of type and figured specimens of rhinoceroses from the lower Tertiary beds of Baluchistan, described and figured by the donor, Mr C Forster Cooper, a large collection of fossil invertebrates from the United States, collected and presented by Miss Mary S Johnston, and type specimens of three fossil fishes described by Prof H H Swinnerton, and presented by him An interesting collection of 727 pebbles, illustrating forms, origins, and materials, has been presented to the Department of Minerals by Mr E J Dunn of Melbourne, who commenced collecting so long ago as 1856

Mr J E Cooper has presented his herbarium to the Department of Botany of the Museum It contains about 2,000 sheets of well preserved flower ing plants, a large number of which are aliens The other specimens are chiefly from the London district, including parts now built over A collection of more than 700 plants has been made by Mr J E Dandy, assistant keeper in the Department, who accom panied an expedition to the Anglo Egyptian Sudan organised by Mr C G T Morison to study soil vegetation relations in an area where there is a big variation in rainfall The area west of the Nile shows a large range between the dry north and the Nile Congo divide in the south Collections were made in many areas which were previously little known, and it is probable that much of interest from the point of view of geographical distribution will result, particularly from that from the high massif of Jebel Marra

Fire Protection of Electric Generating Stations

In the *Electrician* of June 22 there is an interesting account of the method adopted for protecting the large power station of the Bristol Corporation at Portishead from fire, by means of carbon dioxide The great advantage of carbon dioxide for power house use is that it extinguishes the fire with little risk of interrupting the operation of the station The maintenance of a continuous supply of electric power is of the greatest importance in generating stations. The installation consists of carbon dioxide cylinder batteries centralised in a special building situated about 80 feet away from the station Main pipes connect the cylinders with control valves placed at convenient points for directing the gas in the event of fire Entirely automatic operation is arranged only for the transformer compartments, where thermostats are filled which operate the control valve The quantity of gas stored is such that any section pro tected by the system can be flooded with gas more than sufficient to extinguish any fire The draw backs to using chemicals having a water content in rooms containing live electric wires are well known In the event of fire arising in an alternator, there is an initial discharge of gas from ten cylinders As the rotor continues to revolve for about half an hour before it comes to rest, the initial discharge is liable to be dispersed and so the gas concentration might fall too low For this reason ten more cylinders are provided, each of which functions successively at intervals of three minutes and thus a safe degree of concentration is maintained

Interference between High-Power Radio Stations

A REPORT from Science Service dated May 29 states that Dr Balth van der Pol, speaking at a meeting of the Institute of Radio Engineers in Philadelphia has directed attention to the interference which may arise if the power of broadcasting stations is sufficiently increased Dr van der Pol reported that interference has been noticed in Holland between two distant high power European stations separated in wave length by more than 800 metres This interference has been attributed to interaction or cross modulation of the two sets of signals in the passage through the ionosphere (See B D H Tellegen NATURE 131 840 June 10 1933 V A Bailey and D F Martyn NATURE 133 218 Feb 10 1934) The effect is believed to increase rapidly as the power of the sending station increases and if the same phenomenon is found to exist in America, it may prove to be a practical limitation to the power at which radio broadcasting stations can be operated This would appear to be a new problem for the Federal Radio Commission to consider in the United States

Indian Physico-Mathematical Journal

READERS of NATURE may be interested in the *Indian Physico Mathematical Journal* which appears twice yearly It was founded in 1930 for the purpose of publishing original papers on mathematics and theoretical physics, under the editorship of Prof J Ghosh, Presidency College Madras, assisted by a board of eminent Indian scientific workers The latest numbers, which we have recently received contain many interesting papers representative of both the above subjects These form a definite contribution to science and are worthy of more than a local circulation The *Journal* does not belong to any particular institution, but exists solely to encourage research The annual subscription outside India is £1

Manuring of Vegetable Crops

LITTLE exact knowledge of the effectiveness of artificial fertilisers on vegetables is available and further, it seems doubtful whether good crops can be raised indefinitely with the use of artificials alone For these reasons, the Ministry of Agriculture has thought it desirable to collect all the possible information on the subject, and a bulletin compiled by A H Hoare entitled "The Manuring of Vegetable Crops" has just been published (No 71 1*s* net) It is recognised that for economic production a thorough understanding of the fundamentals of soil fertility and its relation to plant growth is required, and the first part of the bulletin deals with this subject in a concise and practical manner Special attention is directed to the possibilities in the less commonly used organic manures that are now available, the need of which is a matter of particular importance for growers on light soils The various types of crops, brassicas, roots, leguminous, potatoes, etc , are then dealt with in turn and the most suitable fertilisers to use in each case and the best time for their application are supplied The requirements of the small scale gardener or allotment holder are not overlooked, and where special instructions for crops intended for canning may be helpful they are included

Leaflets on Diseases of Fruit Trees

THE Ministry of Agriculture and Fisheries has recently issued five new advisory leaflets dealing with fruit tree diseases Leaf Scorch Glassiness and Bitter Pit of Apples (No 203) gives useful descriptions of these three physiological disorders outlines the conditions which produce them and suggests ways in which they may be avoided Advisory Leaflet No 205 (Apple Mildew) replaces Leaflet No 204 and emphasises the need for cutting diseased twigs well back, in order to remove all the fungus Gooseberry Cluster Cup Rust (No 198 , replacing No 209) describes the æcidial stage of the fungus *Puccinia Pringsheimiana* which spends its uredo and teleuto spore stages on certain sedges The æcidial stage occurs on the leaves and fruit of gooseberries causing malformation Control is obtained by hand picking diseased fruits, and removing sedges from the locality The die back disease of gooseberries is treated in Leaflet No 204 (formerly No 234) The fungus *Botrytis cinerea* kills the outer tissues of the stem, usually just above ground level, and the whole bush dies The fungus is usually a saprophyte and its attacks may be controlled by clearing away decaying material from the neighbourhood or spraying bushes with 0 4 per cent copper sulphate solution just before the buds open Powdery Mildew of the Vine (No 207) is an up to-date edition of Leaflet No 133

Research in Bacterial Chemistry

THE Medical Research Council announces the inauguration of new arrangements for further combined chemical and bacteriological investigations into the conditions which govern the life and multiplication of micro organisms causing disease These have been made possible by the generous co-operation of the Middlesex Hospital Medical School the trustees of the late Viscount Leverhulme and the Sir Halley Stewart Trust Accommodation and facilities are being provided at the Middlesex Hospital in the Bland Sutton Institute of Pathology and the adjoining Courtauld Institute of Biochemistry The investigations will be directed by Dr Paul Fildes, who has been appointed a member of the scientific staff of the Medical Research Council The other workers are Mr B C J G Knight, with a Halley Stewart research fellowship, and Dr G P Gladstone and Dr G Maxwell Richardson, holding Leverhulme research fellowships The arrangements took effect on June 1, and the support given by the co-operating bodies is sufficient for an initial period of five years

Leverhulme Research Fellowships

THE following Leverhulme research fellowships have recently been awarded, among others, for research in the subjects indicated Dr E Ashley Cooper, lecturer in chemistry, University of Birmingham (activity of enzymes of bacteria), Prof E E Evans Pritchard, assistant professor of sociology, University of Cairo, Egypt (detailed ethnological and sociological study of the pagan Galla of Western Abyssinia), Dr R MacLagan Gorrie, Indian Forest Service (correlation of erosion damage and grazing in forest lands), Miss M M Green, late Government Education Department, Nigeria (anthropological and linguistic research among the Ibo tribe of Southern Nigeria—joint research with Mrs S H Leith Ross), D Ll Hammick, fellow and tutor, Oriel College, Oxford (interaction of nitro compounds with aromatic bases and hydrocarbons), Dr H Stafford Hatfield (behaviour of crystalline substances in electric and magnetic fields), Dr L S B Leakey, part time lecturer in the Kikuyu language, School of Oriental Studies, London (prehistory of East Africa), Mrs S H Leith Ross, late Secretary, Board of Education, Nigeria (home and social life of the women of the Ibo tribe of Southern Nigeria—joint research with Miss M M Green), N E Odell, geologist to the Louise A Boyd Expedition to N E Greenland, 1933 (structure and metamorphism of the Franz Josef Fjord region of North East Greenland), Dr W H Taylor, assistant lecturer in physics, University of Manchester (application of X ray analysis to the investigation of the structures of organic compounds) Grants in aid of researches have been made to the following, among others Prof K A C Creswell, assistant professor of Muslim art and archæology, Egyptian University, Cairo, Egypt (researches on early Muslim art and architecture), Capt C R P Diver, Senior Clerk, House of Commons (South Haven Peninsula Survey, Studland Heath, Dorset (1) Physiography and history (2) Distribution of populations and ecology of several animal orders), J Reid Moir (prehistoric archæology), Mrs C F Tipper, University of Cambridge (plastic deformation of metals)

Museums Association

THE forty fifth annual conference of the Museums Association will be held at Bristol on July 2–6, under the presidency of Dr Cyril Fox The general theme of the conference will be the modernisation of museums and art galleries Dr Cyril Fox will deliver his presidential address on July 3 A discussion on folk museums will be opened by Dr R E M Wheeler Papers to be read include "The Popularisation of Geology" by Dr F S Wallis, "Maps in the Museum" by Dr F J North, and "Science and the Public Museum" by Prof A E Trueman On July 6, the Gaumont British Co will give a demonstration of "The Film in the Museum" Further information can be obtained from the Secretary, Museums Association, Chaucer House, Malet Places, London, W C 1

International Congress for Applied Mechanics

THE fourth International Congress for Applied Mechanics will be held at Cambridge on July 3–9 The following general lectures will be given Dr V Bush, "Recent Progress in Analysing Machines", Prof A Caquot, "Définition du domain élastique dans les corps isotropes—Courbes intrinsèques de résistance élastique apparante, et de résistance élastique vraie (endurance)", Prof J P Den Hartog, "The Vibration Problem in Engineering", Prof Th v Kármán, 'Turbulence", Prof Ernst Schmidt, "Heat Transmission", Prof G I Taylor, "The Strength of Crystals of Pure Metals and of Rock Salt", Prof Herbert Wagner, "Über das Gleiten von Kärpern auf der Wasseroberfläche" An extensive series of sectional papers will also be read Further information can be obtained from the Organising Secretary, Mr A H Chapman, Engineering Laboratory, Cambridge

Announcements

THE president and council of the Royal Society have recommended Viscount D'Abernon for election into the Society under the special statute which permits the election of "persons who in their opinion either have rendered conspicuous service to the cause of Science, or are such that their election would be of signal benefit to the Society"

THE meeting of the Faraday Society for the general discussion on Colloidal Electrolytes", originally announced for September 25–27, has been deferred to September 27–29 The date has been changed partly to suit the convenience of those who are travelling to the U S S R for the Mendeléeff Centenary Celebrations

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A principal of Watford Technical and Art Institute—The Clerk to Hertfordshire County Council, 28, Castle Street, Hertford (July 4) Five probationary forest officers—The Secretary, Forestry Commission, 9, Savile Row, London, W C 1 (July 4) An assistant lecturer in physics at University College, Nottingham —The Registrar (July 5) A junior scientific officer in the Admiralty scientific pool—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 (July 7) Three geologists on the Geological Survey of Great Britain and Museum of Practical Geology—The Director, Geological Survey and Museum, 28 Jermyn Street, S W 1 (July 9) A professor of surgery in the King Edward VII College of Medicine, Singapore—The Director of Recruitment (Colonial Service), 2, Richmond Terrace, Whitehall, London, S W 1 (July 14) An archæological commissioner in Ceylon—Director of Recruitment (Colonial Service), Colonial Office, 2, Richmond Terrace, Whitehall, S W.1 (July 31) A geologist in the Education Department of the Anglo Egyptian Sudan—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S W 1

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Exchange Forces between Neutrons and Protons, and Fermi's Theory

FERMI[1] has recently developed a successful theory of β-radioactivity, based on the assumption that transmutations of a neutron into a proton and vice versa are possible and are accompanied by the birth or disappearance of an electron and a neutrino.

This theory implies the possibility of deducing the exchange forces between neutrons and protons, introduced more or less phenomenologically by Heisenberg. (This idea occurred also quite independently to my friend, D. Iwanenko, with whom I have since had the opportunity of discussing the question.) Consider two heavy particles a and b, a being in a neutron and b in a proton state. If a becomes a proton and b a neutron the energy remains unchanged. Now these two degenerate states of the system may be linked up by a two-step process: the emission of an electron and a neutrino by the neutron a which becomes a proton, and the ensuing re-absorption of these light particles by the proton b which becomes a neutron. The energy of the system will be in general not conserved in the intermediate state (compare the theory of dispersion). The emission and re-absorption of a positron and neutrino may also take place[2]. In this way the two degenerate states of the system considered are split into two energy states, differing by the sign of the exchange energy.

Since the rôle of the light particles (ψ-field) providing an interaction between heavy particles corresponds exactly to the rôle of the photons (electromagnetic field), providing an interaction between electrons, we may adapt for our purposes the methods used in quantum electrodynamics to deduce the expression for Coulomb forces.

Putting $\psi = \psi_0 + g\psi_1 + g^2\psi_2 +$, where g is the Fermi constant ($\sim 4 \times 10^{-50}$ erg cm^3), and using the theory of perturbations and retaining only that part of ψ which corresponds to the absence of light particles in the initial and final states, we obtain

$$\left(H_0 - i\hbar\frac{\partial}{\partial t}\right)\psi_2 \sim \left(K \mp \frac{1}{16\pi^3\hbar c r^5} I(r)\right)\psi_0,$$

where K is an infinite constant, r is the distance between a and b and $I(r)$ is a decreasing function of r, which is equal to 1 when $r \ll \hbar/mc$ (m is the mass of the electron). Neglecting K, one would obtain the same result if one introduced directly in the wave equation of the heavy particles an exchange energy $A(r)$

$$A(r) = \pm\frac{g^2}{16\pi^3\hbar c r^5} I(r),$$

the sign of $A(r)$ depending on the symmetry of ψ in respect to a and b. Introducing the values of $\hbar$, c and g, we obtain

$$|A(r)| \ll 10^{-85} r^{-5} \text{ erg}$$

Thus $A(r)$ is far too small to account for the known interaction of neutrons and protons at distances of the order of $r \sim 10^{-13}$ cm.

If the difference of masses of the neutron and of the proton is larger than the sum of the masses of an electron and a neutrino, the emission of light particles by a heavy particle may take place without violation of the conservation of energy. But again *the corresponding value of the exchange energy may* be shown to be far too small

$$|A(r)| < g\left(\frac{mc}{\hbar}\right)^3 \sim 10^{-18} \text{ erg}$$

Our negative result indicates that either the Fermi theory needs substantial modification (no simple one seems to alter the results materially), or that the origin of the forces between neutrons and protons does not lie, as would appear from the original suggestion of Heisenberg, in their transmutations, considered in detail by Fermi.

IG. TAMM

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[1] Fermi, *Z. Phys.*, **88**, 161; 1934.
[2] Wick, *Rend. R. Naz. Accad. Lincei*, **19**, 319; 1934.

Interaction of Neutrons and Protons

As electrons and positrons are expelled in some reactions from nuclei, we can try to treat these *light* particles like the photons emitted by atoms. Then the interaction of *heavy* particles (protons, neutrons) can be considered as taking place *via* light particles described by the equations of a ψ-field in the same manner as electromagnetic, for example, Coulomb, interaction takes place through an electromagnetic field, or photons.

The *first* order effects are the expulsion (or absorption) of an electron, which case was treated recently by Fermi, or of a positron. We may remark that the application of Fermi's formalism to positron disintegration of light nuclei (which we get by changing the sign of the charge number and taking for the latter the appropriate value) gives results which fit, though not very accurately, the observed relation between the half-period and the maximum energy of the disintegration particle[1]. Though there seems to be a quantitative disagreement between Fermi's theory (applied to positrons) and positron disintegration, on the other hand the calculated values for K and Rb support Fermi's assumption of the existence of quadripole transitions of heavy particles, giving too big values for the half-periods in comparison with the usual dipole disintegrations. The exceptional position of K and Rb is in some way rather *anschaulich*. We may remark that the Sargent-Fermi rule, in contrast to the Geiger-Nuttall law, shows a less pronounced dependence on the charge number, so that for qualitative considerations even the wave functions of free particles can be used.

The *second* order effects give specially the probability of production of pairs, which is in the case of the ψ-field less effective than in the electromagnetic case, as the charge, e, is much bigger than Fermi's coefficient, g (the 'charge' for the ψ-field). The most important second order effect is the subsequent production and annihilation of an electron and positron, in the field of proton and neutron, which leads to the appearance of an interaction *exchange* energy (Heisenberg's *Austausch*) between proton and neutron, quite in the same way as Coulomb interaction can be conceived as arising from the birth and absorption of a photon in the case of two electrons Instead of e^2/r one gets here an interaction of the order g^2/chr^5, which is easily verified dimensionally The exact calculations were first carried out by Prof Ig Tamm, who also insisted on development of this method With $g \sim 10^{-50}$ (the computations were carried out by V Mamasichlisov), which value is required by the empirical data on heavy radioactive bodies we get an interaction energy of a million volts, not at a distance of 10^{-13} cm but only at $r \sim 10^{-15}$ cm, which is inadmissible We may ask about the value of r, which would give a *self interaction* energy of the order of the proper energy of a heavy particle This value is of the order 10^{-16} cm, which is that of the classical radius of a proton

The appearance of those small distances is very surprising and can be removed only by some quite new assumptions Fermi's characteristic coefficient g appears to be connected also with distances of this order of magnitude

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Physical Technical Institute,
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[1] cf D Iwanenko, *C R. Ac Sci U S.S.R*, Leningrad 2 No 9, 1934

Barium in Ancient Glass

THE recent interesting exhibition of Chinese glass and beads—the property of the Royal Ontario Museum, Toronto—at the Courtauld Institute (University of London) arranged by Prof Yetts, prompts us to put on record the results of some work we have done on ancient beads and the presence of barium in them

The more ancient of the specimens exhibited—for the most part beads—are derived from graves (likely to be known in future as the Han Chun graves) near the village of Chin Ts'un in Honan Careful consideration by Prof Pelliot of the circumstances of their discovery leads him to place the date of these graves, and therefore of the beads, in the second half of the third century B C In China in 1929, and later by correspondence, we were able to collect a number of beads so closely resembling those of Han Chün that they may well have come from that site, and may definitely be regarded as of the same period and make Struck by the weight of a number of these specimens, we proceeded to compare their specific gravity with beads of Mediterranean' origin, and when we found this generally higher a number of analyses were performed It is not now our purpose to discuss our conclusions, but simply to direct attention to the following results

	Specific gravity	Analysis	
Blue glass bead with white inlay (Fig 1)	3 57	SiO_2	41 9 per cent
		PbO	24 5 ,,
		BaO	19·2 ,,
		CaO	4 5 ,,
		Fe_2O_3 Al_2O_3	4 4 ,,
		Alkalis	4 5 approx
		CuO	trace
Glass ear ornament	3 5	Contains 10 per cent mixed calcium and barium oxide, of this an appreciable amount is barium oxide	

The ear ornament is of the type sometimes known as capstan bead', and there is good evidence for regarding it as of Han date (202 B C–A D 221)

In modern times barium glass was not made until about 1884, when it was one of the new glasses with a high refractive index and low dispersion put on the market by Messrs Schott of Jena, nor have we any knowledge of any ancient glass or bead containing barium

We do not suggest that the ancient Chinese used barium purposefully in their glass—no doubt it was present in the material from which the glass was made, we do, however, consider that its presence may in the future allow of the determination of origin of beads in certain doubtful cases, and thus have some value in questions of early culture contacts between West and East, indeed it was the study of these that led us to our discovery

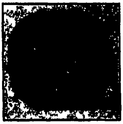
FIG 1 Bead of Han Chün type Natural size

It must not, however, be supposed that all Chinese glass of a high specific gravity, or all Han glazes, contain barium Dr F M Brewer, who has kindly examined by arc spectroscopy two specimens of Chinese glass and a piece of typical green Han glaze, reports that 'there was not in any of them any barium either as main or minor constituent' Of the two pieces of glass, one of T'ang age (A D 618–907) has specific gravity 2 5 the other—believed to be of this period—a specific gravity of more than 5

H C BECK
C G SELIGMAN

Rapid Growth-Rate and Diminishing Heterogony

A STUDY of relative growth in the pistol crab, *Alpheus dentipes*[1], has disclosed an interesting modification of the simple heterogony law, as expressed by the relation $y = bx^k$, where y and x are magnitudes of organ and body respectively, and b and k are constants k representing the coefficient of growth-partition between organ and body[2]

This relation may hold over very long periods—for chela weight in fiddler crabs, for example, apparently *during a two hundred fold increase in total weight*[3] The principle, however, may be modified in various ways One modification in particular may be mentioned here, namely, that found in the mandibles of Lucanidæ Here, in the upper part of the absolute size range, the actual values for organ size fall progressively further below the expected values This has been interpreted as due to growth occurring in a closed system, namely, the pupa · if the heterogonic organs are very large, they will not be able to complete their growth before the rest of the body has appropriated most of the reserves of nutrient material[3]

Something analogous appears to occur in the chelæ of *Alpheus* In males (for brevity's sake the only sex considered here) between the smallest and largest classes of the size range 3–10 mm carapace length, the small (nipper) claw has a greater growth-partition coefficient than the much larger (crusher) claw ($k = 1$ 22 as against 1 19)[1,4] When all the class means are considered, however, the log-log curve, instead of being a straight line, is concave downwards This is best shown when the square root of the two most rapidly growing dimensions—width and thickness (depth)—is used as a measure of chela magnitude (Fig 1) This applies both to crusher and to nipper claws, but is both more pronounced and of earlier onset in the crusher The *k* values for equivalent growth periods are shown in Table 1

TABLE I Growth of chelae in ♂ *Alpheus dentipes*

Period (classes)	Growth coefficient (*k*)	
	crusher	nipper
I II	1 99	1 34
II III	1 24	1 42
III V	1 10	1·49
V VII	1·09	1 10
VII IX	0 47	0 59

The interpretation would appear to be as follows — The growth coefficient of the crusher in very small males, outside the range of the table must be extremely high (well over 2) to produce the large relative size found at 3 mm carapace length The high rate proves physiologically impossible to maintain as the bulk of the crusher increases, and the growth coefficient therefore falls progressively The nipper has only a moderate heterogony (*k* never over 1 5), which it maintains (and indeed appears to increase slightly) up to a quite large body size then it too shows a decrease

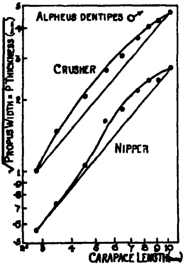

FIG 1 Double logarithmic plot of the chelae of ♂ *Alpheus* against carapace length

It must be left undecided whether the temporary increase of the nipper's relative growth just noted is associated with sexual maturity, and whether the very rapid decrease in the growth rate of both claws after class VII is a post maturity phenomenon, as seen in the secondary sex characters of *Gammarus*[4] What appears clear is the *diminishing heterogony* of the crusher, visible from carapace length 3–8 mm and deducible at earlier stages, and this would appear to be the direct outcome of an initial excessively high growth rate The phenomenon would be comparable to the diminution in total growth consequent on increased absolute size as noted by Hesse in various animals without a blood system[5]

While on the subject of heterogony, a further point may be noted The terms *positive* and *negative heterogony* originally employed[3] to denote relative growth with *k* values above and below 1 0, have proved in some ways misleading as suggesting that antagonistic processes are dominant in the two cases The alternative terms *hypergony* and *hypogony* are proposed accordingly, indicating that what is being considered is the level of an organ's growth intensity relative to that of the body as a whole

BEN DAWES
JULIAN S HUXLEY

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King's College
London
May 30

[1] Dawes Ben (*a*) *Arch Entw Mech* 130 649 1933 (*b*) *ibid* 1934 (in press)

[2] Huxley J S Problems of Relative Growth pp 11 31 London Methuen 1932

[3] Huxley J S, *J Linn Soc* (*Zool*) 37 675, 1931

[4] Kunkel B W and Robertson J A *J Mar Biol Assoc* 15 655, 1928

[5] Hesse R Ueber Grenzen des Wachstums Jena G Fischer, 1927

The Helmholtz Resonance Theory of Hearing

In a communication to NATURE of April 21 p 614, Messrs Hallpike and Rawdon Smith produce evidence of differential sensitivity of different parts of the cochlea to notes of different frequency, which they describe as favouring the resonance theory of hearing They use the expression 'differentially tuned" which I suggest assumes more than is justified by the evidence

There is one feature which the resonance theory does not explain, and that is that the human hearer cannot name the harmonics entering into the compound tone unless those harmonics are made loud enough to cause actual reversal of the primary wave I recall Prof Silvanus Thompson directing attention to this in 1898, at which time I demonstrated for him at a conversazione of the Royal Society a model illustrating an alternative theory of hearing due to Dr Max Meyer The following is Thompson s note on the Meyer apparatus

According to Max Meyer the ear does not act as a resonator and the perception of the individual tones of a compound sound does not depend on the fibres of corti acting as resonators His view is that disturbances communicated by the stapes to the inner ear travel up the basilar membrane to distances dependent on amplitude and damping, and that the perception of tone depends upon the number of times per second that the direction of such motion is changed The model does not profess to exhibit the mechanism of the ear, but to show, by the number of times that certain lamps light up in a single period, that a mechanism which is sensitive to changes of direction of motion can act as an analyzer of compound periodic motions

The Meyer apparatus depended upon a loose coupling between a series of parts Dr Meyer did not claim to have discovered a corresponding structure in the cochlea The action of the Meyer apparatus was consistent with the above stated peculiarity of human hearing as well as with differential sensitivity of different parts of the cochlea and suggests a closer examination of the process and mechanism of travel of sound throughout the length of the cochlea

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May 29

Nuclear Structure, γ-Ray Fission, and the Expanding Universe

PROF G W TODD[1] has put forward evidence against the suggestion that the positron is a constituent of the nucleus He states that for a definite atomic mass P, and a definite atomic number Z, the arrangement of α particles, neutrons, etc , in the atomic nucleus should be such as to give a unique structure for the nucleus Allowing the possibility of positrons but excluding the possibility of unattached electrons Todd constructed the following arrangement for the unique structure

$$\tfrac{1}{2}(Z - K)\ \alpha \text{ particles} + (P - 2Z + 2K) \text{ neutrons} + K \text{ positrons}$$

where $K = 0$ or 1 whichever makes $\tfrac{1}{2}(Z - K)$ an integer

For reference Todd s table for α and β ray transformations from uranium is given below (n stands for neutron and p for positron)

	Nucleus			Radiation
UI	46	+ 54n	+ 0p	
↓ UX	45	54	0	α
↓ UX$_2$	45	54	1	β
↓ UII	46	50	0	β
↓ Io	45	50	0	α

We find as UX$_1$ is transformed into UX$_2$ the following change takes place $0 \rightarrow 1p + 1\beta$ the positron remaining in the nucleus

Prof Todd asks Where do the electron and positron come from in this change ? If we accept the suggestion that a γ ray of sufficient energy may undergo fission into a positron and an electron in the strong electric field of the nucleus the apparent anomaly may be explained Now β ray emission was preceded by *emission of α particles* and *if some* α particles without getting out of the nucleus just shift their positions from higher energy levels to lower levels there would be emission of energy which would appear as γ ray radiation Some of the γ rays would very likely undergo fission into positrons and electrons within the nucleus The positron of the γ ray would attach itself to the nucleus and thus increase the atomic number by one and the β particle would escape

We find that as UX$_2$ is transformed into UII, a new α particle is created according to the transformation

$$4n + 1p \rightarrow 1\alpha + 1\beta,$$

the α particle remaining in the nucleus This transformation can also be explained by assuming that an α particle is an aggregate of four neutrons and two positrons, and also a positron and an electron were created out of a γ ray and the two positrons combined with the four neutrons to form the α particle It may be pointed out that a β ray transformation is usually accompanied by γ ray radiation The binding energy of a proton is presumably great, and so its dissociation into its constituent parts can not be spontaneous Naturally we come across a comparatively small number of neutrons and positrons

Dirac has suggested the possibility of a negative proton[2] A plausible hypothesis may be formulated according to which super γ rays or cosmic ray photons may also undergo fission into positive and negative protons A proton has the energy of $9 4 \times 10^8$ electron volts, and a cosmic ray photon may have the energy of the order 10^{11} electron volts

The breaking up of a photon into an electron and a positron or into a positive proton and a negative proton may be helpful in explaining why our universe started expanding from the Einstein universe We know that, mass for mass, matter exerts less gravitational attraction than radiation So the conversion of radiation into matter will lessen the gravitational factor Therefore if by some method the photon breaks up into two material particles, the Einstein universe will start expanding Possibly radiation, as well as the fundamental material particles, already existed in the Einstein universe Some of the photons broke up into constituent particles in the electric field of already existing charged particles and thereby started expansion

I also feel that the final end of the universe as predicted by Sir James Jeans, due to all matter ultimately dissolving away into radiation, may not happen as materialisation of radiation is possible, and electrons, positrons, positive protons and negative protons can be created or re formed out of the photons It may also be mentioned here that Prof Tolman established the possibility of a universe in which reversible processes take place, without entropy reaching a maximum or free energy a minimum

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March 21

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[1] NATURE 132 65 July 8 1933
[2] *Proc Roy Soc* A 133 1931

Afterglow of Carbon Dioxide

IN a recent paper[1] it has been shown that carbon dioxide, when excited to luminescence by an electrical discharge in a vacuum tube, possesses a blue violet afterglow having a spectrum similar to that obtained by burning carbon monoxide in air or oxygen The spectrum has now, on the suggestion of Prof A Fowler been produced from a modified source which is brighter than the afterglow in the gas at low pressure

A powerful uncondensed spark from an 18 in induction coil was passed between water cooled aluminium electrodes in a spherical bulb of about three litres volume , the spark was horizontal , the distance between the electrodes was variable, but the best results were obtained with a separation of about five centimetres The bulb was filled with carbon dioxide at a pressure of about a quarter of an atmosphere It was observed that the spark, which resembled an arc, was accompanied by a blue glow above it This glow persisted for a fraction of a second after the cutting off of the discharge

The spectrum of this glow has been examined between 6000 A and 2900 A , and found to be similar to the spectrum of the afterglow at low pressure and to that of the carbon monoxide flame The water vapour band at 3064 A , which was such a prominent feature of the spectrum of the afterglow, was however, not observed when the gas was carefully dried Even when the gas was slightly wet showing the water vapour band in the spectrum of the exciting spark, this band was still quite weak in the spectrum of the glow above the spark This supports the view that the presence of water is not essential to the occurrence of the afterglow The spectrum of the exciting spark consisted of the third positive and Angström bands of carbon monoxide, the afterglow bands were also present on the spectrograms of the spark, but this does not necessarily imply that they were present in the exciting spark as the glow was also included in these spectrograms No lines of atoms other than those of aluminium from the electrodes, were observed in the region examined

The effect of variation of the pressure of the gas has been studied At a pressure of about half an atmosphere the glow was brighter but the spectrum included a considerable amount of continuous background resembling the carbon monoxide flame as usually obtained At a pressure of about 100 mm the glow was much fainter and the spectrum more nearly resembled that of the afterglow in a vacuum tube, showing a well marked band structure and being comparatively free from continuum

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May 31

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[1] *Proc Roy Soc* A 142 302 1933

Absorption Spectrum of Mercuric Sulphide

WE experimented with the absorption spectrum of gaseous mercuric sulphide The substance was introduced into a quartz absorption tube which could be heated to about 400° C by electrical means steps being taken to prevent condensation on the plane quartz ends The copper and aluminium under water sparks were used as sources of continuous radiation The sulphide seems to decompose very readily and we obtained evidence only of the presence of Hg vapour by the resonance line 2536 A and of S_2 and, at high pressures, of S_8 by the sulphur bands, which we identified without much difficulty At higher pressures the overlying continuum becomes very prominent, and the banded structure disappears, as is usually the case with a gas under such conditions

We would not have published these results were it not for the fact that recently Sen Gupta[1] claims to have shown that mercuric sulphide dissociates in three regions of continuous absorption into Hg ($^1S_0$) and S (^3P) S ($^1D_2$) S ($^1S_0$) respectively We re-examined our plates in the hope of verifying this, and can only say that the separation of these distinct absorptions from the sulphur continuum must be one of very great difficulty In fact, we cannot be sure if the first two regions are not entirely due to sulphur, which has two maxima, 4000 A in the S_8 region and 2670 A in the S_2 region Our absorption spectra for HgS followed very closely the spectra published for sulphur at high pressures by Graham[2]

The heat of dissociation of HgS has been calculated to be 60–70 kcal This makes the reaction $2HgS = Hg + Hg + S_2$ endothermic so that the dissociation will be greater at the higher temperatures and pressures, and there will be a relatively larger concentration of S_2 compared with HgS Consequently the interference effect due to S_2 will become more and more pronounced as the temperature is raised and it seems useless to try to increase the concentration of HgS in this way

The whole question of the existence of an absorption spectrum of HgS would seem to centre round the electronic state of the molecule If it is a $^1\Sigma$ ground state it would not dissociate into Hg ($^1S_0$) and S (^3P) as these atomic states do not combine to give a singlet state (Wigner and Witmer, Herzberg, etc) Whether the first excited state dissociates in this way will depend on the probability of the intercombination, so that the absorption spectrum of HgS in the necessary region may only be very slight and perhaps immeasurable

It is noteworthy that V and C Meyer[3] found HgS to have a vapour density (compared with air) of 5 39 The vapour density of $Hg + Hg + S_2$ is not much different from this namely 5 35

T IREDALE
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April 24

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[1] *Proc Roy Soc* A 143 438 1934
[2] *Proc Roy Soc* A, 84 311 1910
[3] *Ber* 12 1282 1879 See also Scott *Proc Roy Soc Edin* 14 410 1887

Intranuclear Spindle Formation and Mitosis in *Artemia salina*

CYTOLOGICAL studies on *Artemia* have brought out some new facts about the structure of the spindle and the morphology of the meiotic and mitotic division in this form which agree only in part with previous hypotheses (For a recent discussion of these see Schrader[1]) To what extent these data bear upon the general understanding of the problem of mitotic division will be considered elsewhere in more detail

In *Artemia* the spindle, both in meiotic and cleavage divisions is formed exclusively from nuclear material It arises as two half spindles from the poles of the nucleus inside the nuclear membrane which remains intact up to early metaphase (Fig 1 *a*) Its formation is accompanied by a steady loss of nuclear volume indicating that the process involves a great reduction in the fluid content of the nucleus During metaphase the nuclear membrane rapidly disappears

There is a distinct structural difference between the polar fibres and the spindle fibres The metaphase spindle is barrel shaped and in early cleavage divisions stands out sharply against the polar fibres of the big centrospheres It has a very similar form in the metaphase of the meiotic divisions where there are no formed centrosomes or centrospheres and in the late cleavage divisions, where these are only weakly developed (Fig 1 *b*)

In the spindle two components can be distinguished (1) relatively rigid fibres immersed in (2) a less viscous matrix During anaphase, the chromosomes move to the two poles leaving a much lighter central space (Fig 1 *b*) The fibres found in this central space between the two sets of chromosomes would seem at first sight to correspond to Schrader's interzonal fibres, but in this case they appear to be identical with one component of the metaphase spindle, namely, the rigid fibres

It may be suggested that during anaphase the chromosomes are moving as on tracks—or possibly within tubes as suggested by Schrader—along these rigid fibres The anaphase spindle is more cylindrical and less compact than the metaphase spindle One can see the underlying yolk granules through it whereas this is impossible in metaphase These facts suggest that there is a streaming of the interfibrillar substance—the matrix between the rigid fibres—towards the centrospheres and that the movement of the chromosomes is somehow connected with the currents thus produced

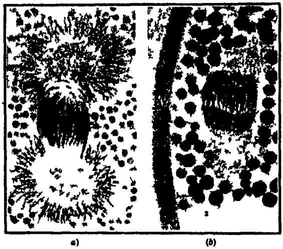

FIG 1 (a) Early metaphase of the first cleavage division in a diploid parthenogenetic *Artemia* Intranuclear formation of the spindle × 590
(b) Anaphase of a late cleavage division in a polyploid parthenogenetic *Artemia* The centrospheres are here weakly developed as compared with the first cleavage Note that the polar regions are denser than the space between the two sets of chromosomes × 1 320

As soon as the chromosomes reach the ends of the spindle they lose their regular arrangement in planes and form more or less spherical clumps This is consistent with the assumption that the rigid fibres act as supporting structures and at the same time separate the chromosomes from each other The spindle remnant is always to be seen in telophase It is noteworthy that in the first cleavage division the chromosomes after leaving the spindle and assuming the clumped telophase arrangement may continue their movement towards the centrospheres

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Z wiss Zool 142 1932

The Discovery of *Acanthinula harpa*, Say, in Central Siberia

IN the course of a study of the molluscan fauna of Siberia carried out under the auspices of the Smithsonian Institution during 1932 and 1933 a point has come to light which appears to merit special notice This concerns the discovery of the gastropod mollusc *Acanthinula harpa* Say in central Siberia This species has long been known to occur in Europe North America and the eastern fringe of Asia (Kamchatka etc) and its apparent absence from the central part of Siberia led Dall[1] to believe that migration into that territory had been delayed by a transgression of the sea or of glacial ice over at least a part of this region

The collection of *A harpa* in three different localities in the central part of this region namely near the River Ket (to the north of Tomsk) at a point situated two hundred and ten kilometres above the River Ob on the western shore of Lake Baikal in the vicinity of the village of Listvinichnoye and on the eastern shore of the same lake twenty five kilometres north east of the mouth of the River Selenga indicates that this is a circumboreal species and obviates the need on these grounds of the hypothesis noted above

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[1] Dall W H 'Land and Freshwater Mollusks Harriman Alaska Expedition 13 New York 1905

Activities of Life and the Second Law of Thermodynamics

I AM at one with Profs Donnan and Guggenheim in hoping that this discussion will end soon but ask leave to explain why I think that their supposed paradox[1] is merely a third mare's nest

It is a well known and indeed obvious fact that entropy has different values according as it is measured with reference to atoms or molecules or other units Profs Donnan and Guggenheim have re-discovered this hail it as a paradox and claim that because this paradox exists my arguments must be unsound As well might they rediscover the paradox that temperature has different values according as it is measured on the Centigrade and Fahrenheit scale and try to use this as ammunition against anyone who mentions temperature

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[1] NATURE 133 869 June 9 1934

Crocodiles or Alligators

PROF RITCHIE need have no fear that the name *Crocodilus* for the crocodiles in general will be replaced in future by *Champse*[1] It was unfortunate that Dr Werner's blunder should have appeared in so authoritative a work as Das Tierreich but it was at once corrected by Dr Stejneger in *Copeia* No 3 p 117 Oct 1933 The type of *Crocodilus* both by absolute tautonymy and by subsequent designation is *niloticus*=the *Lacerta crocodilus* of Linnaeus (in part)

MALCOLM SMITH

[1] NATURE 133, 835 June 2 1934

Constitution of Astacin

ASTACIN the pigment of the lobster and of other crustaceans is a derivative of β carotene that is 5 6 5′ 6 tetraketo β carotene or 4, 5 4 5 tetraketo β-carotene It forms a dioxime $C_{40}H_{48}O_2=(NOH)_2$ which besides the two oxime groups also contains two enolic hydroxyl groups On heating with *o* phenylenediamine astacin gives a di phenazine derivative $C_{52}H_{56}N_4$ It is therefore a new type of carotene derivative

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Research Items

Cannibalism in North-West America A study of mortuary and sacrificial anthropophagy on the north west coast of America and its origins has recently been published by Dr William Christie MacLeod (*J Soc Américanistes* N S , 25, fasc 2) Among the Kwakiutl there is a group of dances either cannibalistic or related to the cannibal dance A youth who in his quest for a vision meets the great cannibal spirit or any of the cannibal s attendants, acquires the dance, derivable from the spirit An analysis of the elements of this belief and of the lore connected with cannibalism indicates that the dance was diffused from the northern Kwakiutl as the centre It is evident, however, that the dance consists of a number of elements which were diffused separately and have been only imperfectly integrated among the Kwakiutl There are three elements which have a different history and can be traced Of these corpse eating by the relatives of the deceased was an old culture element of the entire west coast of North America and the northern plateau It was linked with the custom of bone carrying by the widow and the custom of smearing with exudations of the corpse, or its blood, as an equivalent of eating Among the Kwakiutl the custom of mortuary anthropophagy probably represents a survival from the culture of a pre Kwakiutl tribe The second element the custom of biting bits of flesh from fellow tribesmen at ceremonials is of inner American introduction and probably is a by product of hook swinging In inner North America the rite is self sacrifice of bits of skin Thirdly, non anthropophagous sacrifice of captives in war was diffused to the west coast from inner America, and afterwards, through the Kwakiutl, anthropophagous practice followed in connexion with the rite of hook swinging The strips of flesh technique in sacrifice of both Maidu and Kwakiutl is of inner American origin and still survives among the northern Plains and Woodlands Indians

Rabbit Fur Production As a rule rabbit fur has been worn in garments only when no other could be afforded, objections to it being that the hair soon becomes worn and shabby in appearance and, curiously enough that it is cheap In recent years however, much has been done by careful selection and breeding to improve the lasting quality of rabbit fur, and to furnish a wide range of desirable colourings As a result, it is now possible to produce natural undyed and untrimmed furs which closely resemble pelts from the rarer and more expensive fur bearing animals Much of the progress has been due to the discovery in 1919 of a mutation, later known as castorrex, in which a short, dense, under fur with almost a velvety texture is the predominant coat, the guard hairs of the outer fur being reduced to insignificance The rex-coat character acts as a Mendelian recessive, and breeders armed with a knowledge of the behaviour of this character in crossing have to their hand an invaluable aid in producing coat varieties new in colour and texture The Ministry of Agriculture and Fisheries has published a Bulletin (No 73) on 'Rex furred Rabbits" (London H M Stationery Office 1*s*) which gives a description of experiments carried out by W King Wilson at the National Institute of Poultry Husbandry The pamphlet illustrated by eleven fine reproductions of colour photographs of stages shown in the first and second generations of hybrids resulting from a cross between normal furred lilac and castorrex, should be a useful guide to the breeder It would be interesting to know if these beautifully coloured natural furs stand exposure to light without fading

Hair Direction in Man and Apes Dr T D Stewart, physical anthropologist of the Smithsonian Institution has made a preliminary classification of the differences in hair growth directions over the whole body between man and the higher apes The comparisons are based upon 156 skins of gorillas, chimpanzees and orang outangs and upon young men stripped for physical examination There is much in common between the two groups, which possess a basic hair direction pattern from which each species has departed to some extent In man the pattern has become more modified than in any of the others, the most obvious human feature being the cow lick on the top of the head In the apes the head hair streams regularly backward from forehead to nape (like that of a modern well oiled youth !), and this direction is continued without break along the back where the hair streams downward from neck and shoulders It is in the back pattern of man that the most striking divergence appears for instead of showing a regular downward flow, the hair of each side converges towards the mid line Man has the most complex and most variable pattern, but the difference between man and any of the anthropoid apes is greater than that between any two of the apes

Whaling in the Dominion of New Zealand Capt Cook visited New Zealand in 1770 1773 and 1774 and he was the first to report whales in those seas In Discovery ' Reports, 7 239 252, 1933, Mr F D Ommanney gives a brief outline of the history of the whaling industry in New Zealand and a sketch of the small industry as it exists to day One of the first attempts at large scale whaling in the vicinity of New Zealand was made in 1791 by a fleet of whalers which had arrived in Australasian waters through having brought convicts and stores to Australia It met with no success because although whales were abundant enough the weather proved too bad for profitable fishing Seven years later, however, Sperm whaling was being actively carried on in New Zealand waters, mainly by British and American ships the chief bases of which were situated at the northern end of South Island By the end of the third decade of the nineteenth century the population of Sperm whales in those waters had become seriously depleted As a result of this diminution in the number of Sperm whales and also because of an increasing demand for Right whale oil and whalebone a Right whale industry arose in 1830 and quickly eclipsed the Sperm whale fishery in importance Ten years afterwards this fishery, too began to decline owing to diminution of the whale population by ruthless overfishing, and by 1892 the New Zealand whaling industry had sunk to insignificance Several recent attempts to revive it have been disastrously unsuccessful At present there are only two whaling stations operating on a small scale in New Zealand —one at Whangamumu and one at Torry Channel Queen Charlotte Sound

Fæcal Pellets from Marine Deposits. Mr Hilary B Moore has already made several studies of the fæcal pellets of various marine animals, finding in them good diagnostic characters for certain species In vol 7 of the 'Discovery" reports, 1933, he describes a type of pellet occurring frequently in the plankton at some stations which he recognises as agreeing in form with those of euphausiids found in the Clyde He believes them to belong almost certainly to *Euphausia superba* which is very abundant in the plankton at the same stations They were not found in the bottom deposits, probably because they break down quickly, as was observed in the Clyde, where they were seen at the extreme surface of the mud but not below The pellets from the bottom deposits are not so easily identified although they can be separated into two classes One appears to be from a mollusc, possibly *Nucula*, and includes many diatoms, the other, which is much more abundant, is of a kind the distribution of which is world wide, occurring in recent deposits in depths from 0 to more than 2 000 m and in conditions varying from almost fresh to salt water, also in certain fossil deposits These pellets are ovoid and composed of the same mud in which they are found and are probably of animal origin The author is inclined to attribute them to polychæte worms or to molluscs The former seems very likely as he has found similar pellets in the Clyde which come definitely from Maldanid worms

Ascidiacea of the North Sea The section on Ascidiacea by J Huus, in 'Die Tierwelt der Nord und Ostsee (Lief 25, Teil xiia$_2$. 1933 Leipzig Akademische Verlagsgesellschaft m b H) opens with a useful account in about 10 pages of the external features and internal anatomy The author recommends weak acetic acid as a narcotising agent for these animals which, unless narcotised, contract strongly on preservation The systematic section, with its diagnoses and key, is followed by a list showing the distribution of the 55 species considered An excellent summary of the physiology of Ascidiacea is given, attention is directed to glands of unknown function, such as the pylorus glands and the neural gland The author notes that the latter is known to develop from a part of the larval brain, that Julin pointed out its homology with the hypophysis, and that Butscher found its extract has the specific action of posterior lobe hormone The development is briefly considered, a first key to the larval forms of the area is provided, and due attention is given to the process of budding The section concludes with a list of the animals which live symbiotically with or parasitic within or upon, Ascidiacea

Discoloration in Preserved Latex. A very valuable discussion of this subject by Edgar Rhodes and K C Sekar will be found in the *Journal of the Rubber Research Institute of Malaya* of March 1934 Extending earlier observations by de Vries, it can be shown that such discoloration can usually be traced to the presence of soluble iron, and the presence of the iron may often be associated with acid production due to fermentative changes with the consequent solution of iron from metal containers This soluble iron then may react with hydrogen sulphide or other soluble sulphide, the sulphide being produced as a rule by the gradual hydrolysis of the protein material in the latex, a process taking place more readily under alkaline conditions, which may occur as the latex before shipping is usually treated with ammonia Thus acid production following collection, associated with iron containers, and then sulphide production following ammoniation before shipping, are accessory factors in discoloration The discussion of this problem may enable grower and shipper to combine to reduce the discoloration in the latex which otherwise makes it unsuitable for many of the new processes in which rubber latex is now being utilised

Vegetation of Prairies The April number of *Ecological Monographs* (4, No 2, 109–295, 1934) is a general account of prairie vegetation by J E Weaver and T J Fitzpatrick The areas which prairie occupies are characterised by cold winters and hot summers, with a growing season of about seven months, during which there is a fairly even distribution of rainfall amounting to 19–20 inches The total annual rainfall is from twenty five inches in the north west increasing to thirty six inches in the south east Despite the high temperatures and considerable wind, water is almost always present below six inches and this is rendered available by well branched root systems which tend to form three underground strata The shallowest roots mostly extend to a depth of about a foot, but the unleached deep organic soil, which is well aerated, permits the development of deeply penetrating root systems, some of which even extend to seventeen feet below the surface Six types of prairie are distinguished by their floristic constitution, the most important being those dominated by *Andropogon scoparius* and *A furcatus* All the dominants and most of the other important species are perennials which reproduce mainly by vegetative means Most of the prairie areas are stated to have been mown annually for more than fifty years and this, together with the fires and grazing to which they have been subject since prehistoric times, have checked the tendency shown by the more feral areas to form communities of a few dominants only At the contacts with woodland and forest, colonisation by shrubby species occurs, though their growth is checked by the factors just mentioned *Rhus glabra* and *Symphoricarpus vulgaris*, both of which spread by vegetative means, are important pioneers in such suppressed scrub, but it is suggested that even if not checked by mowing and fire, chaparral and woodland could not greatly extend the areas which they at present occupy In this connexion it must, however, be borne in mind that the authors themselves emphasise that the prairies are associated with a wide range of conditions both as to soil and topography A considerable part of the text of this monograph consists of notes, of varying merit, upon the constituent species

Blight Diseases of Leguminous Plants. A study of various fungi which produce disease on legume crops in India has recently been published (*Trans Brit Mycol Soc*, 18, Part 4, 276–301, April 1934. "A Comparative Study of the Fungi associated with Blight Diseases of certain cultivated Leguminous Plants" ,by Dr A Sattar) Nine species or forms of fungi which cause foot rots of pea, gram, lentil and vetch are described The symptoms of each fungus are given for its respective host plants, and cultural characters of the parasites have been determined *Ascochyta pisi*, a fungus which is well known in England as a parasite of the garden pea, was found to have physiological forms on vetch and lentil *Phyllosticta Rabiei* also has a close relation with its host (gram), whilst *Mycosphærella pinodes* and *Ascochyta pinodella* are not so specialised. The last two organisms cause very severe foot-rot. Considerable discussion of the results of the experiments as they relate to taxonomy appears in the paper, and it is suggested that *P. Rabiei* should be more correctly named *A. Rabiei*.

Earthquakes in Bulgaria. With the exception of Greece and Italy, no European country is more frequently disturbed by violent earthquakes than Bulgaria. It is therefore fortunate that it should possess an efficient seismological service, the work done by which during the last forty years is described in an interesting paper by M. Kiro P. Kiroff, the director of the Central Meteorological Institute (*Matér. pour l'Étude des Calam.*, No. 32, 341–348, 1933). The service was founded by M. Spass Vatzoff, the director at that time. A table is given of the number of earthquake days during each month of 1892–1931. From this it appears that on an average there were 44·4 days every year on which earthquakes occurred, the highest yearly numbers (213 and 134) being those for 1904 and 1928, including the after-shocks of the destructive earthquakes in April of each year. During the forty years, there were eight earthquakes of destructive intensity with epicentres either in Bulgaria or close to its borders.

Gravity Work in East Africa. The annual report 1934, of the Committee for Geodesy and Geophysics at Cambridge gives a short account of the notable work done by Dr. and Mrs. Bullard in the recent Cambridge Gravity Expedition to East Africa. Dr. Bullard was in Africa from last November until early April this year, and during that period made gravity observations at 57 stations, several of which were visited twice and some three times. The tour extended from Nairobi through the west and north-west part of Kenya, Uganda, the southern Sudan, part of the Belgian Congo to the west of the Rift Valley, and back to Nairobi through Uganda. Dr. Bullard then proceeded to Mombasa through Tanganyika, and from Mombasa by coast to Cape Town, making shore observations at Dar es Salaam and Cape Town. The photographic records of the observations, which were made with invar pendulums by Dr. Bullard's comparison method, were sent to Cambridge weekly by air mail. The reductions are not yet complete, but it appears clear that the accuracy obtained is of a high order. Dr. Bullard also made valuable magnetic observations on his tour, using instruments lent by the Ordnance Survey and the Carnegie Institution of Washington. These observations included 159 of declination, 58 of horizontal force and 18 of inclination.

Insulators. The mechanism by means of which flow of electricity takes place in materials which are almost insulators is still obscure, but the publication of Prof. Joffé's address to the International Congress on Physical Chemistry on the subject, and the discussion which followed, will do much towards clearing away the obscurity (Pp. 35. Paris: Hermann et Cie, 10 francs.) In the case of an insulating crystal, Prof. Joffé considers that the thermal oscillations are sufficient to detach an ion occasionally from its normal position in the space lattice of the crystal, and that the absence of the ion from that position and its presence elsewhere produce deformations of the space lattice which are propagated by the electric field applied to the crystal, but gradually disappear owing to the thermal movements replacing the ions. When this process takes place slowly, the resistance of the crystal may be very small. Prof. Joffé believes that in no case has the replacing ion to overcome an energy barrier. He considers that the retention of conductivity by a crystal when its temperature is suddenly reduced points to the fact that in a crystal some ions exist displaced from their normal positions, and that their number increases with temperature and with the passage of light or X-rays. The pamphlet is to be followed by one on conduction by electron movements.

Strychnine and Brucine. The constitution of these two alkaloids has proved a very difficult problem to the organic chemist, and further communications to the *Journal of the Chemical Society* (May 1934) by Prof. R. Robinson and collaborators (the first bearing the name of the late Prof. W. H. Perkin) bring the number of parts of the work up to twenty-nine. The problem is not yet fully solved but considerable progress has been made. An important contribution is the progress made in the Hofmann degradation of the molecules, which has hitherto proved very intractable. It had been recognised that both strychnine and *neo*strychnine are of the allylamine type, and that Hofmann eliminations in the series of the dihydro bases in which the allylamine structure is no longer present might be a promising line of investigation. This is now shown to be the case. A very interesting and unexpected reaction was also discovered in the reduction of a new base, leading ultimately to a new isomeride of dihydrostrychnidine. The previous suggestion that strychnidone obtained by the oxidation of *neo*strychnidine is a keto-amide has also been confirmed. A method of oxidation of *neo*strychnine derivatives by perbenzoic acid is described. The papers contain a number of important observations which cannot be summarised adequately without reference to other previous ones in the series, and it is clear that the solution of the problem of the constitution of strychnine is considerably advanced by the work now recorded.

First Dissociation Constant of Phosphoric Acid. Phosphoric acid is a comparatively weak acid and has the peculiarity that the acid function of its three hydrogen atoms varies greatly. The dissociation constants are important in physiology and the values for the first dissociation constant $(H_3PO_4 \rightleftharpoons H^+ + H_2PO_4^-)$ available are not in very good agreement. L. F. Nims (*J. Amer. Chem. Soc.*, May) has determined this constant, expressed in terms of activities, over the temperature range 0°–50°, from electromotive force measurements of the cells

$$H_2/HCl(m_1),\ KH_2PO_4\ (m_2)/AgCl/Ag,$$

without liquid junctions. The limiting Debye-Huckel equation $\log \gamma = -A\sqrt{\mu}$ was used for the activity coefficient of HCl, the ionic strength μ being expressed by $m_1 + m_H$, in which m_H is the apparent hydrogen ion molality from the electromotive force equation. The values of $pK_1 = -\log K_1$, K_1 being the first dissociation constant of phosphoric acid, were found by graphical extrapolation of very satisfactory lines. The equation $\log K_1 + 2·0304 = -5 \times 10^{-5}\ (t + 18°)^2$ was found, t being temperature centigrade. The values so obtained are in very good agreement with those found by conductivity at 18°, and by the quinhydrone electrode at 37·5°, by other experimenters.

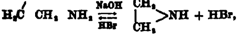
Speeds of Chemical Reactions in Biological Processes

SEVERAL interesting points were raised at the discussion on June 14 at the Royal Society on methods of measuring and factors determining the speed of chemical reactions The discussion, which was opened by Prof A V Hill had as its main objective the exploration of methods suitable for attack on biological problems

Several of the difficulties in such work are now generally recognised, we must note, for example, that physical methods of attack are likely to prove more fruitful than chemical methods since there are few reagents that do not disturb in some manner the complicated series of reactions proceeding in living matter Again, in the chemical laboratory it is customary to restrict one's attention to reactions in solution which proceed at speeds conveniently measurable In biological systems it is the reactions which are predetermined and their velocities have to be measured Whilst a half life of some ten seconds after mixing the reactants is almost the limit of accurate measurement by the usual methods many biologically important reactions proceed much more rapidly Prof H Hartridge and Dr F J W Roughton showed how, by means of specially designed mixing chambers using liquids at high pressures and optical or electrical examination of the mixed liquids in flow reaction velocities having a half life of as small as 1/4,000 sec could be determined An extension of this method by Mr G Millikan involving a photoelectric cell permits of a greater degree of sensitivity and the elaboration of a micromethod

The modern extension of the kinetic theory of reactions to complicated molecules is bringing into prominence the importance of what is termed the steric factor, thus a very large molecule undergoing reaction at one of its constituent groups may be regarded as only potentially active over a relatively small fraction of its total area These steric factors may play an important part in biological reactions in two somewhat dissimilar fields We find that steric factors already intrude in such comparatively simple homogeneous reactions as the addition of hydrogen to, say, the double bond in propylene, and may anticipate that there is indeed a very large steric factor in the reactions of, say, oxygen with hæmoglobin It will be interesting to examine from this point of view the results obtained from measurement of the reactions of the less common and extremely large molecule biological pigments, the molecular weights of which as determined by the super centrifuge, run into the millions

Again numerous biological processes occur at phase boundaries or interfaces, and such reactions possess several interesting peculiarities which are well worth extended investigation Prof H Freundlich pointed out that whilst surface catalysis is a relatively common phenomenon, there are cases in which retardation of a chemical reaction can be brought about by a simple extension of surface, he cited as an example the reaction

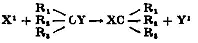


$$\mathrm{H_2C(Br)\ CH_2\ NH_2 \underset{HBr}{\overset{NaOH}{\rightleftharpoons}} \begin{matrix}CH_2\\ |\\ CH_2\end{matrix}\!>NH + HBr,}$$

which is retarded by charcoal in alkaline solution It is difficult to decide whether the adsorbed molecules are firmly adsorbed and so removed from the solution, to which the reaction is confined, or whether reaction is proceeding both in solution and in the adsorbed layer, but in the latter, which may be regarded as an organic medium, the reaction proceeds much more slowly

In the case of monolayers at fluid interfaces, it is a simple matter to contract or extend the area per molecule by means of a Langmuir trough, and it is possible to examine reaction rates in monolayers by determination of the rate of change in the phase boundary potential As has been shown in the present writer's laboratory at Cambridge the velocity constants of numerous reactions in monolayers may be altered to a marked extent by extension or contraction of the film Thus there is remarkable decrease in the rate of oxidation (by dilute permanganate solution) of the double bonds in a monolayer of oleic acid on suitable compression of the film, or, to suggest a possible analogy to stretched muscle, there is an increased rate of oxidation on extension of the film The action of enzymes on monolayers of reactants for example, lecithinase on films of lecithin is similarly sensitive to an alteration in the molecular concentration or steric factor, which in these cases can be controlled at will

In addition to the steric factor the energy of activation plays a dominant part in determining the rate of chemical action, and it is still a matter of speculation as to the accuracy of assessing the magnitudes of the individual energies of activation in the complex chain of biochemical processes Prof M Polanyi pointed out that many ionic reactions in solution require energies of activation and that unsuspected reactions may indeed be taking place. He cited as a typical example the racemisation of optically active halides by negative ions, which reaction may be written



$$X^1 + \begin{matrix}R_1\\ R_2\\ R_3\end{matrix}\!>CY \rightarrow XC\!<\!\begin{matrix}R_1\\ R_2\\ R_3\end{matrix} + Y^1$$

Where X^1 and Y^1 are identical, that is, $X^1 = Y^1$, racemisation can take place without the occurrence of any apparent chemical reaction although in fact an ion exchange does take place

Both in chemistry and in physics, a vast number of relative speeds of complicated processes are found to be exponentially temperature dependent, and the mechanisms of these processes are always interpreted on an atomistic hypothesis Prof J B S Haldane pointed out that either this inference may not be universally legitimate or a materialistic concept must be given to such curious processes as the subjective measurement of time, for here the logarithm of the relative speed of counting is found to vary inversely as the absolute temperature of the counter, giving a computed energy of activation of 24,000 calories The speed of bimolecular gas reactions is accelerated by increase of pressure, and the recent experiments carried out by the Imperial Chemical Industries at Northwich have revealed a surprising increase in velocity of many chemical reactions in the liquid phase when suitably high pressures are employed Prof Max Cmcatel directed attention to this as a possible method of effecting a sudden change in the environment of a living system and examining the effect of this change on the various reactions taking place

Some brief references were also made to the importance of finding a really accurate method for measuring the true permeability rates of extremely thin membranes Theoretical investigations in this field have already been made by Prof A V Hill and Dr F J W Roughton indicated how the streaming method could be made applicable to blood cells thus permitting an examination of the true rates of ingress and egress both of non electrolytes and of ions

ERIC K RIDEAL

Water Supply

It is natural and appropriate that the paramount topic of the drought should find a prominent place in the presidential address of Mr Councillor Thomas Paris at the annual meeting of the British Waterworks Association (Incorp) at Edinburgh on June 27 Much of what he had to say respecting the pernicious effects of a shortage of water has been a matter of common experience but he made the pertinent observation that many of the failures in supply can be traced to procrastination and lack of courage in promoting water schemes This was more particularly in reference to rural areas where he emphasised the importance of an abundant supply of wholesome water is hardly to be over estimated since insufficient or impure water in those areas has wide reaching effects on public health through milk and foodstuffs produced for general consumption He alluded to the frequent lack of storage facilities and urged all councils regional urban and rural to take action in the direction of increasing their storage and where necessary constructing new waterworks Another of his points was river pollution which he contended in the national interest must cease He instanced the case of Edinburgh where a few years ago there was a turbid stream flowing through the city offensive to eye and nostril The action taken by civic authority has resulted in the transformation of a public nuisance and a menace to health into a fished water He is opposed to the formation of a national water grid alleging that the argument for such a grid so far as Scotland is concerned is without foundation The question in his view is not one of water shortage but rather of storage and distribution

Among the papers contributed to the Conference was one of a particularly timely character on the Consumption Misuse and Waste of Water Mr John Bowman the author of the paper, directed attention to the striking difference in the quantities of water supplied per head per day by various authorities He gave a list of 114 authorities in England each supplying a population of more than 50 000 in which the consumption ranged from 13 00 to 73 45 gallons per head per day Another list showed that among 27 water authorities in Scotland the consumption ranged from 34 to 92 gallons per head per day Commenting on the subject of undue consumption which might be defined as the use of more water than is necessary he said a person living in a country where water is scarce may find it possible to perform all his ablutions with one gallon of water per day and half as much again for culinary and drinking purposes In civilised countries it would appear that at least from 4 to 6 gallons per head must be allowed where there is no water used for baths or water closets Where water is used in addition for the supply of water closets it would appear that the lowest figure is about 10 gallons per head Much depends on the class of property Houses of the residential class have a higher *per capita* consumption than small tenements

Mr Bowman went on to ask the question What is to be regarded as the future requirements for ordinary domestic consumption ? He gave it as his opinion that within the next twenty years at least 20 gallons per head per day would have to be provided for the increased use of baths The requirements per head per day would then be in the region of 50 gallons Perhaps forty years from now a consumption of 80 gallons might be considered possible In American towns 80 gallons per head is looked upon as a normal consumption Dealing with the question of waste which he attributed largely to defective fittings he stated that a good deal of it might be eliminated by the installation of heavy service piping and good fittings Useful work he thought might be done in educating the householder in the avoidance of waste due to faulty fittings and in getting him to see that taps were left properly turned off and to use water without undue consumption

Fish Preservation in Trawlers

With the introduction of steam driven vessels —somewhere about the year 1870—the great development of the present long distance deep sea trawling industry became possible But the industry s present greatness is not due to steam alone Had not the practice of stowing the catch in crushed ice been also introduced about the same time the bringing back of fish in a saleable condition from far distant grounds would have been impossible even for large and powerful steamers unaffected by the vagaries of wind propulsion

In recent years many experiments have been made in an endeavour to evolve and perfect a more satisfactory method of preserving fish at sea In spite of every effort towards improvement however the stowage of trawled fish in crushed ice is still the general practice notwithstanding its very serious limitations

The preservative effect of crushed ice is two fold By lowering the temperature of the fish tissues changes due to autolysis are slowed down This lowering of temperature also slows down the rates at which the bacteria of decay grow and multiply, but stowage in crushed ice alone cannot inhibit their activities completely

Bacteria of decay are present on the fish when caught but only in negligible numbers As at present handled on board ship after capture, however the fish become very heavily infected with these organisms As a result of this severe infection, storage in crushed ice will in general maintain fish in a really fresh state for not more than 6–7 days Important researches at the Torry Research Station, Aberdeen[1], have shown that, with care, infection of the fish after capture can be so greatly reduced that they will remain fresh in crushed ice up to a maximum of 10–12 days By greater attention to cleanliness, therefore, a marked improvement could be brought about in the quality on landing of ice preserved fish

Following upon its researches along these lines, the Torry laboratory has now issued a pamphlet[2] directing the attention of owners, skippers, and mates to certain points of importance which should be observed in the treatment of their catches if they are to obtain maximum returns from them

Many of the recommendations are of a purely common sense kind, such as minimum handling of the fish and greater attention to washing with clean water of decks, pounds, baskets and fish room fittings Certain additional precautions are also suggested, the most important and most practicable of which are the use of town supply or other clean water heated to 180° F (see below) for scrubbing all fittings, boards and baskets after the catch has been landed, and the scrubbing of the fish room with town water to which has been added 5 parts per 100 of 40 per cent formaldehyde The fish room should finally be sprayed with the same solution At sea, and before the next catch is stored, the fish room must be again hosed down with sea water in order to remove all traces of the disinfectant

While the better preservation of the catch is to be sought in greater cleanliness, attention to certain details of stowage is also recommended It is pointed out that stowed fish should be protected so far as possible from all draughts, as these hasten the melting of the ice The use of vegetable parchment for this purpose at least for the more valuable species, is advocated as being remarkably effective in preventing wasteful melting caused in this way

A noteworthy and most commendable feature of the foregoing recommendations is that they require little or no outlay of extra capital or additional running expenses, and can be immediately put into practice, with, it is claimed, marked improvement in the quality of the fish landed

Certain other recommendations are also put forward which entail the installation of special equipment and involve more radical changes in the present normal routine on board ship At all points where the fish come into contact with the ship or its fittings, it is suggested that heavily galvanised steel be used to replace or to cover the usual wood, galvanised steel baskets should be substituted for wicker ones, additional pipes and connexions should be installed on deck to facilitate more thorough washing of the fish after gutting, and a heater is advocated for providing water at a temperature of not less than 180° F

Although there can be little doubt of their theoretical desirability, it is not likely that these special and somewhat costly fittings will be quickly and generally installed throughout fishing fleets But this in no way detracts from the immediate value of the other and simpler recommendations It is to be hoped that the general distribution of these leaflets amongst them will induce deep sea trawlermen to test out the proposals on their own vessels without any further loss of time This result achieved, sufficiently enhanced returns will be adequate incentive to ensure the permanent and universal adoption of the improved methods To any less practical arguments trawlermen one and all will pay but little attention

G A S

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[1] Food Investigation Special Report, No 37 The Handling and Stowage of White Fish at Sea (London H M Stationery Office) 1s 6d

[2] Department of Scientific and Industrial Research Food Investigation Leaflet No 3 The Care of the Trawler's Fish By A Lumley Pp 4 (London Department of Scientific and Industrial Research 1933) Free

Annual Gathering at Rothamsted

THE annual gathering of subscribers to the Rothamsted Experimental Station, held on June 20, had, this year, a special significance and there was a record attendance On this occasion, the title deeds of the Rothamsted Estate, which has now become the property of the Lawes Agricultural Trust, were formally handed over to the Trustees by Mr Walter Elliot, the Minister of Agriculture The chairman of the Trust Committee, Lord Clinton, who presided at the meeting, announced that a telegram of congratulation had been received from Lord Bledisloe, Governor General of New Zealand, a former chairman of the Lawes Trust Lord Clinton then briefly outlined the reasons that compelled the Committee to issue its recent public appeal for £30,000 to purchase the estate The land on which the building stood, and the fields containing the unique long period experiments were threatened by building developments He paid a warm tribute to Mr R McDougall and the Sir Halley Stewart Trustees, who provided £20,000, and to Sir Bernard Greenwell, Bart, whose early offer of £1,000 set a standard for the numerous private subscribers and organisations As a result, the balance was quickly obtained, and the future of Rothamsted is secure for all time

The director, Sir John Russell, said that the interest in Rothamsted is well shown by the wide spread area from which subscriptions came, and by the cosmopolitan nature of the visitors at the annual meeting He took this as evidence that the policy of Rothamsted is on the right lines the purpose of the Station is not to teach farmers how to farm, but to give them information that they can use in solving their varied problems on their own farms

Mr Elliot congratulated Rothamsted on the successful outcome of the appeal While it is a pity that an estate, which has been for three hundred years in the possession of one family, has to change hands, it is clear that no more suitable new owners could be found than the organisation Sir John Lawes set up himself An old tradition has been broken, but a new one has begun which will produce equally great results for agriculture and England The work of Rothamsted will go on at its present level, for the appeal fund has provided an unmistakable vote of confidence from the agricultural community

Prof H E Armstrong, vice chairman of the Trust Committee thanked Mr. Elliot for his remarks, and joined with Lord Clinton in congratulating the Minister on his efforts in reorganising the agricultural industry He said that agricultural scientific workers, thanks to Lawes, have solved one vital problem the production of sufficient quantity of produce The next great task is the question of quality, for if animals and human beings were properly fed there would be little or no disease

During the day the visitors were conducted around the farm and the laboratories The classical experiments on grassland, wheat, and barley were inspected, and special attention was also given to recent experimental developments

There is on the farm a number of half bred ewes with four well developed teats These are being mated to a young half bred F_2 ram, bred on the farm, also with four teats, to ascertain whether ewes with this characteristic are better mothers than those with two teats

An important investigation on the technique of animal feeding experiments was also demonstrated Its purpose is to reduce the variations hitherto associated with this type of experiment by applying the modern statistical methods of design already worked out at Rothamsted for experiments on crops An interesting feature of this experiment, which is devoted to pig feeding is that each animal is fed individually in its own trough enclosure opening off the main pen In this way all types of rations can be distributed equally over all groups of pens in contrast to the usual practice in which all pigs in a group are on the same ration

The investigations on the use of electricity in farm buildings attracted much attention Numerous farm and barn operations can conveniently be performed by electrical power and measurements are taken of the number of electrical units required as compared with the amounts of fuel consumed by internal combustion engines doing the same work This information is not, at present, available for the farmer who contemplates employing electrical power, and it is the purpose of the experiments at Rothamsted to supply it

In the afternoon the work of the laboratories was inspected, and demonstrations were given of certain investigations which have reached the stage of practical development Among these were the inoculation of lucerne, the purification of effluents from sugar beet and milk factories, methods of measuring the properties of flour doughs, and a number of problems associated with bee keeping and the grading of honey

University and Educational Intelligence

GLASGOW —The honorary degree of LL D has been conferred on the following, among others W R Cunningham, University librarian and keeper of the Hunterian books and manuscripts, Prof H M Macdonald, professor of mathematics, University of Aberdeen, Sir Harry McGowan chairman of Imperial Chemical Industries, London, Prof Frederick Soddy, professor of inorganic and physical chemistry, University of Oxford

LIVERPOOL —Dr G C McVittie has been appointed to a lectureship in applied mathematics rendered vacant by the election of Mr R O Street to the chair of mathematics in the Royal Technical College, Glasgow Dr Mary W Parke has been appointed algologist at the Marine Biological Station, Port Erin, for the coming year, and Mr R G Bruce naturalist in charge of the Station

LONDON —Prof L N G Filon has been re elected vice chancellor for the year 1934–35, and Dr George Senter, principal of Birkbeck College, deputy vice chancellor for the same period

On the occasion of the celebration of Foundation Day 1934 the honorary degree of D Sc will be conferred on Prof Karl Pearson and the honorary degree of D Litt on Dr A F Pollard

A university postgraduate travelling studentship of the value of £275 has been awarded for one year to Arthur Herbert Cook (Imperial College—Royal College of Science) Mr Cook proposes to carry out chemical research in the Universities of Zurich and Heidelberg

OXFORD —In presenting Prof A V Hill for the honorary degree of D Sc at the Encaenia held on June 20, the Public Orator, Mr Cyril Bailey spoke of his singular devotion to the study of physiology, and especially of his most accurate investigations of the conditions of muscular activity As a Balliol man he regretted that Prof Hill his fellow scholar at Blundell s, had preferred to go to Cambridge, but sometimes gifts were to be given to the Danai In conferring the degree the Chancellor, Lord Halifax, addressed Prof Hill as ' most exact of men, who have dealt so acutely with physiology, that we account scarcely any of the secrets of the human frame as foreign to you"

Among the other honorary degrees conferred was that of D C L on Sir Henry Miers

A SCOTTISH National Conference on the Place of Biology in Education' has been arranged by the British Social Hygiene Council to be held in City Chambers, Edinburgh, on October 19 The president will be the Right Hon Sir Godfrey Collins, Secretary of State for Scotland, and among the speakers will be some of the leading Scottish biologists, who will deal with biology in the school and university and in its relation to man Further information can be obtained from the Secretary General, British Social Hygiene Council, Carteret House, Carteret Street, Westminster, S W 1

Science News a Century Ago

Colonisation of South Australia

The colonisation of Australia owed much to the writings of Edward Gibbon Wakefield (1796 1862) who it has been said, brought to the subject for the first time the mind of a philosopher and statesman, equally fitted for framing a comprehensive theory and for directing its working in practical detail' Wakefield's book, Letters from Sydney', published in 1829, was followed by the formation in 1830 of the National Colonisation Society, while his book, England and America', 1833, which contained a chapter on the art of colonisation, was followed by the inauguration of a company with the title of the South Australian Association On July 1, 1834, this company held a public meeting in Exeter Hall, at which its aims were set forth, and soon afterwards the matter engaged the attention of Parliament Later in 1834, the Colonisation Commissioners for South Australia were appointed and under their auspices the first settlers left England in 1836, arriving in Australia on December 28, Capt (afterwards Rear Admiral Sir John) Hindmarsh being the first Governor of the Colony

Scott Russell's Steam Carriage

John Scott Russell (1808–82) the famous naval architect and shipbuilder who with Brunel constructed the *Great Eastern* was a student at the Universities of Glasgow St Andrews and Edinburgh and when Sir John Leslie professor of natural philosophy at Edinburgh died in 1832 he was selected to fill his place temporarily About this time he turned his attention to steam vehicles and on July 2 1834 took out a patent That year no fewer than six of his carriages were at work in Scotland The subject however was not pursued and he then turned his attention to the study of waves and the resistance and construction of ships for which he is remembered to-day

Prof Hausmann of Göttingen

On July 5 1834 Prof Johann Friedrich Hausmann the German mineralogist and geologist who occupied a chair at Göttingen sent a letter to the editor of the *Philosophical Magazine* disclaiming a statement that he had been a pupil of Mohs whom indeed he did not know though he esteemed him highly Hausmann who was born in Hanover in 1782 studied at Brunswick under Knoch and then at Göttingen under Blumenbach From 1803 until 1806 he was engaged in the mines of Brunswick in 1809 was inspector general of mines in Westphalia and was appointed to the chair at Göttingen in 1811 He made many excursions into Sweden Norway France Holland and England and wrote many works Already in 1803 and therefore earlier than Mohs he said in his letter I became a mineralogical writer building my system on peculiar views belonging to no other school I was the first who appeared as opponent to Werner assisted in the spreading of Haüy's theory and published my first system in 1809 founded on chemical composition and external character I gave in 1813 a complete Handbuch on Mineralogy

Newton's House

The *Mechanics Magazine* of July 5 1834 contained the following note We are glad to observe from the newspapers that Mr Thomas Steele has revived his laudable project for preserving the house and observatory of the illustrious Newton [in St Martin's Street Leicester Square] by enclosing it in a monumental building with a lofty dome—in the same manner as the primitive chapel founded by St Francis at Assisi in Italy is enclosed by the great Franciscan church of more modern times Steele's project never came to anything the house stood until 1913 and its site is now occupied by a fine building the Westminster Public Library on which is a tablet referring to Newton

Sir Gilbert Blane, F R S

A correspondent has pointed out in connexion with the paragraph under this title in NATURE of June 23 p 957 that Sir Gilbert Blane established in 1830 with the sanction of the Admiralty a fund for the encouragement of Naval Medical Science This fund which is vested in the Royal College of Surgeons is employed for providing an annual Gold Medal for the medical officer who obtains the highest place in the examination for promotion to Surgeon Commander.

Societies and Academies

LONDON

Royal Society, June 21 P D F MURRAY Uncoordinated contractions caused by egg white and by alterations in the cation ratio of the medium in the heart of the chick embryo *in vitro* If suitable fragments of chick embryos in primitive streak stages be explanted into the egg white of four or five day eggs there occurs a differentiation of contracting cardiac tissue The contractions differ from those seen in similar explants in plasma in lacking coordination each cell contracting independently of the others When entire hearts of 2½ day embryos are similarly explanted into egg white the coordinate beat always stops and is usually replaced by uncoordinated contractions This anarchic activity is given the provisional name of twitter It is caused by the high potassium content aided by the lower but still rather high calcium content and by the low content of sodium K MELLANBY The site of loss of water from insects An apparatus is described which will measure the amount of water evaporated from an insect and is accurate to a hundredth of a milligram The rate of loss of water from three species of insects was determined (1) in dry air (2) in air to which 5 per cent of carbon dioxide had been added and (3) in a mixture containing less than 1 per cent of oxygen In insects with a spiracle closing mechanism the rate of loss of water under (1) and (2) (which caused them to keep their spiracles open permanently) was 2 7 times that in dry air In insects which could not close their spiracles the rate of loss of water was practically the same under all conditions 2 per cent carbon dioxide is sufficient to cause insects to keep their spiracles permanently open oxygen has to be reduced below 1 per cent to have the same effect From these experiments it appears that practically all the water evaporated is lost by way of the tracheal system and that a thin integument may be just as watertight as one which is highly sclerotised P A BUXTON and D J LEWIS Climate and tsetse flies laboratory studies upon *Glossina submorsitans* and *tachinoides* It is already known that the number of tsetse flies which can be captured under standard conditions rises and falls with the season and that many of the species are sharply limited to particular types of vegetation It is thought that the limits are climatic Observations made under controlled conditions in the laboratory support those made in the field taken together the results should tend to give precision to the control of *Glossina*, which will probably be achieved by altering the vegetation and with it the micro climate

PARIS

Academy of Sciences, May 7 (*C R* 198 1645–1728) A COTTON and TSAÏ BELLING The use with the large Bellevue electromagnet of a supplementary coil for experiments in magneto optics where the pencil is normal to the lines of force Details of construction and measurements of the fields obtained C MATIGNON and M SÉON The preparation of ethylene and its homologues by cracking heptane in the presence of steam Heptane and steam heated to about 900° C give gas mixtures rich in ethylene and its higher homologues practically no carbon monoxide is formed E L BOUVIER New considerations on the African saturnites JEAN BAPTISTE

Senderens The action of sulphuric acid, cold or at a moderate temperature, on aromatic acids and esters Aromatic acids in which the carboxyl group is directly united to the nucleus are not sulphonated either at the ordinary temperature or at 80° C Aromatic acids of the type of phenylacetic acid give sulphonic acids in the cold and at 80° C Lucien Daniel The action of repeated grafting carried out on the descendants of absinthe grafted on *Chrysanthemum frutescens* Paul Lévy Complement to the study of the *V* and *W* spaces O Lovett Certain skew curves generalising conics M Sypták The hyper circumferences and hyperhelices generalised in Euclidian spaces of *p* dimensions Al Pantazi Conjugated stratifiable quadruples P Thullen The essential singularities of analytical functions of several complex variables N Lusin The decomposition of ensembles J Bernamont and M Lévy The properties of mountings with counter reaction Mlle M Quintin The influence of gases on the unilateral conductivity of the silicon carbon couple The nature and pressure of the gas exert an influence on the electromotive force of silicon carbon rectifiers Mme Lina Guastalla The process of oxido reduction at the level of a membrane interposed in a cupric solution in the course of electrolysis N Thon The nature of electrode capacity in alternating current Auguste Piccard The constitution of cosmic rays A discussion of the corpuscular and electromagnetic theories of cosmic rays and an attempt to reconcile the two views A Naherniac The study of a characteristic band of the OH function in the near infra red (about 0 96μ) A comparison of the bands produced in the liquid and vapour states and of the differences between the bands for primary secondary and tertiary alcohols Maurice Curie and S Takvorian The fractionation of actinium in the presence of rare earths Georges Fouretier The measurement of the concentrations during the photographic recording of chemical reactions Henri Moureu and Paul Rocquet The transformation of phosphorus pentanitride into phosphorus mononitride The nitride P_3N_5, heated in a vacuum at 700° C gives off one molecule of nitrogen leaving the nitride PN Mme P Rumpf The formation of perchromates in solution The view of Schwarz and Giese that the blue perchromate corresponds to the formation of the peranhydride CrO_5 is confirmed by a physicochemical method Pierre Süe Study of the action of sodium carbonate on niobium pentoxide G Dupont W Zacharewicz and R Dulou The synthesis of myrtenol and myrtenal Mlle Vera Paraskova The action of ethylmagnesium bromide on sebacic bis diethylamide Mlle M Veiler An abnormal reaction of hypochlorous acid on dimethylpentenol A Lepape L Moret and G Schneider The mineralisation of the thermal waters of Aix les Bains (Savoy), and its geological signification Study of the helium argon ratio in the gases from nine springs From the data given it is impossible that the hot springs of Aix les Bains could have acquired their mineral content from Triassic strata Armand Krempf The maregraphic inscription of the cycles of retrogradation of the nodes of the moon by certain reef making corals Paul Chauchard Some physicochemical characteristics of the water of the bay of Villefranche Jean Lugeon Polar atmospherics C L Alexanian The establishment of the chart of anomalies of the vertical component of the earth's magnetic field in the Vosges Mme Elisabeth David Sylvain The large Foraminifera of the Visso (Central Apennines) synclinal W Drabovitch and A and B Chauchard Conditioned reflexes and chronaxy E Fischer Piette The vertical distribution of the organisms fixed in the zone of fluctuations of the sea Jellinek The rôle of the structure of the tissues in their heating by short waves A and R Sartory J Meyer and J Cueni The lipido protein equilibrium in the serum of patients attacked by skin affections or lipæmic troubles

Leningrad

Academy of Sciences (*Comptes rendus* No 6) I Vinogradov New theorems on the distribution of quadratic residues A N Kolmogorov Convergence of series of orthogonal polynomes S G Michlin Reduction of fundamental problems of the theory of elasticity to an integral equation of Fredholm V Gogoladze The general problem of the integration of a generalised wave equation with variable coefficients G K Putkov A proof of the principal property of the canonical distribution for any given aggregate S Roginskij and A Shechter The recombination of oxygen and hydrogen atoms on metallic surfaces The process of recombination includes a stage involving an energy of activation of 2 000 cal some of the experimental results disagree with the Bonhœffer series At temperatures of 700° C practically every atom that strikes a platinum or palladium filament recombines and gives its energy to the filament, the heating of filaments can therefore, be used for absolute measurements of the concentration of atoms I Knunjanz G Chelinzev and I Osetrova A new synthesis of acetopropyl alcohol An easy method was found in the reaction of ethylene oxide with the sodium salt of aceto acetic ester in a solution of absolute alcohol N Demjanov and A Ivanov The action of N_2O_3 on allene and on dimethylbutadiene (diisopropenyl) Both substances with N_2O_3 in ether solution produce nitrosites of the composition $C_3H_4N_2O_3$ and $C_6H_{10}N_2O_3$ from which a diamine of dimethylbutadiene, $C_6H_{10}(NH_2)_2$ was obtained I N Nazarov On the metall ketyls of the aliphatic aromatic series The α branched alkyls, particularly the tertiary ones are able to increase the dissociation and this ability depends on the degree of their branching and the molecular weight P Budnikov The reduction of sodium sulphate to sodium sulphide B Morozov The stimulating action of embryonic extracts and of tissues on regeneration in Amphibia Both the regeneration of the dorsal fin and the general growth of tadpoles and axolotls was very strongly stimulated by feeding them with powdered human embryo one and a half or two months old B Barcinskij On the germination of the seeds of *Orobanche cumana* The seeds can germinate in distilled water but the process is greatly stimulated by the cellular content of the root of the host plant (sunflower) The introduction of an extract from the roots into the soil induces the seeds of the parasite to germinate so that this may be used as a method of control V Pospelov Imaginal diapause and sterility of butterflies A symbiotic fungus *Endomyces* living in the fat body of certain moths and accumulating reserve products can under certain conditions attain parasitic status and prevent the development of the ovaries S Chernov On the systematics and distribution of *Agkistrodon* (Ophidia) in the Soviet Union Diagnoses and notes on the distribution of four sub species of *A halys* Pall, and of *A blomhoffii ussuriensis* Emel E P Slastenenko A new blennoid fish *Blennius knipowitschi* sp n from the Black Sea

ROME

Royal National Academy of the Lincei November 19 S Pincherle Linear operators and factorial coefficients U Cisotti Differential deductions from the definition of reciprocal vectors geometrical applications (3) A Bemporad Stellar currents about R A $16^h + 52°$ Decl Q Majorana Experiments on metallic photo resistance at high frequency Further experiments confirm the view that light exerts a direct action on the electrical resistance of metallic laminæ This action is not manifested in its entirety with the promptitude characteristic of the classical photoelectric phenomenon there being a difference in phase between the light and the resistance which is sometimes less than is required by the theory of the propagation of heat G Ascoli Conditions for the validity of Taylor's abbreviated formula G Fubini Ghiron A unicity theorem for the equation

$$\frac{d^4u}{dx^4} + \frac{d^2u}{dx^2} + \frac{d^2u}{dt^2} = 0$$

B Segre Geometric functional determination of groups of covariant points relative to a linear system ∞^2 of curves on an algebraic surface Natalie Rein Qualitative characteristics in the restricted problem of three bodies in a gravitating medium A Colacevich The orbit of the spectroscopic double τ Persei A new orbit appreciably different from that calculated from the Lick Observatory observations alone is now calculated from all the observational data available F P Mazza and C Zummo The liver dehydrogenase of the higher fatty acids (2) Addition of a fatty acid either saturated (stearic) or unsaturated (oleic) increases the consumption of oxygen by the liver by 85 or 82 per cent The two acids are thus oxidised equally well by the liver which must therefore contain a complex system effecting the oxidation Of this system the dehydrogenase recently described by Mazza and Stolfi forms one of the components namely that which passes into the aqueous liver extract and is most persistent G R Levi and M Tabet X ray examination of electrolytic silver deposits With bright electrolytic silver deposits obtained from silver bromide in baths rich in sodium thiosulphate the form of the particles is with a high degree of approximation isodiametric Such deposits are therefore widely different from those of chromium in which the brilliancy of the deposits is connected with the flatness of the granules With the silver deposits the direction of growth is perpendicular to the octahedral face

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Forthcoming Events

Friday July 6

Geologists Association at 7 30 —(in the Architectural Theatre University College Gower Street W C 1)— Sir Arthur Smith Woodward Some Recent Studies of Fossil Vertebrate Animals in North America

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Museums Association July 2–6 Annual Conference to be held at Bristol

Dr Cyril Fox Presidential Address

Discussion Folk Museums to be opened by Dr R E M Wheeler

Dr F J North 'Maps in the Museum

Dr A E Trueman Science and the Public Museum

International Ornithological Congress July 2–7 To be held at Oxford

Fourth International Congress for Applied Mechanics July 3–9 To be held at Cambridge

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Official Publications Received

GREAT BRITAIN AND IRELAND

Society of Dyers and Colourists The Jubilee Issue of the Journal of the Society of Dyers and Colourists 1884 1934 Edited by Dr F M Rowe and E Clayton Pp xii+228+xxxv (Bradford) To Junior Members 5s Members 12s 6d , non Members 25s

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1570 (I C E 884, 951) Comparative Engine Tests with Petrol and Butane By P H Stokes and F G Code Holland Pp 66+28 plates 4s net. No 1578 (Spin 159 and 175) Modern Spinning Tests of an Interceptor Fighter By A V Stephens and R H Francis Pp 17+2 plates 1s net No 1579 (T 3456) Continuous Rotation Balance for Measurement of Yawing and Rolling Moments in a Spin By P H Allwork Pp 6+3 plates 9d net (London H M Stationery Office)

The National Physical Laboratory Metrology Department. Tests on Volumetric Glassware Pp 34 (Teddington National Physical Laboratory) Free

OTHER COUNTRIES

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 79 The Lucerne Flea *Smynthurus viridis* L (Collembola) in Australia By Dr J Davidson Pp 66+5 plates (Melbourne Government Printer)

Ontario Research Foundation Report for the Year 1933 Pp 93 (Toronto King's Printer)

Contribution from the Department of Botany University of Nebraska No 82 The Prairie By J E Weaver and T J Fitzpatrick (Reprinted from Ecological Monographs 4 April) Pp 109–295 (Lincoln Nebr University of Nebraska)

Allahabad University Studies Vol 10 (Arts and Science) Pp iv+375+3 plates (Allahabad The University) 7 8 rupees

Education, India Progress of Education in India 1927–32 By Sir George Anderson (Tenth Quinquennial Review Vol 1) Pp iv+273 (Delhi Manager of Publications) 2 14 rupees 5s

Koninklijk Nederlandsch Meteorologisch Instituut No 102 Mededeelingen en Verhandelingen 35 Oppervlaktetemperatuur in het Noordwestelijk gedeelte van den Atlantischen Oceaan (Surface Temperature in the Northwestern Part of the Atlantic Ocean) By P M van Riel Pp 92+8 plates 1 70 fl No 106a Ergebnisse Aerologischer Beobachtungen 21 1932 Pp iv+38+4 plates 1 50 fl No 106a Ergebnisse Aerologischer Beobachtungen 22 Aerologische Beobachtungen und Terminbeobachtungen in Reykjavik während des Internationalen Polarjahres 1932–1933 Pp xiii+27+6 plates 1 50 fl No 108 Seismische Registrierungen in De Bilt 19 1931 Pp viii+58 0 70 fl ('s Gravenhage Algemeene Landsdrukkerij)

Annuaire de l'Académie Royale de Belgique 1934-C Pp 264+3 plates (Bruxelles Maurice Lamertin)

Canada Department of Mines Mines Branch Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories) 1932 (No 736) Pp iv+237+2 plates (Ottawa King's Printer)

Canada Department of Mines Geological Survey Memoir 171 Geology and Ore Deposits of Copper Mountain British Columbia By V Dolmage (No 2344) Pp ii+69 25 cents Summary Report 1933 Part A (No 2350) Pp 82 25 cents Summary Report 1933, Part C (No 2347) Pp 44 25 cents (Ottawa King's Printer)

Mémoires du Musée Royal d'Histoire Naturelle de Belgique Mémoire No 50 Bryozoaires oligocènes de la Belgique conservés au Musée Royal d'Histoire Naturelle de Belgique Par F Canu et R S Bassler Pp 26+4 plates Mémoire No 51 La faune des grès et schistes de Solières (Siegenien Moyen) Par Eug Maillieux Pp 90+2 plates Mémoire No 56 Revision du genre Mallomonas Perty (1851) incl pseudo-Mallomonas Chodat (1920) Par Dr W Conrad Pp 82 Mémoire No 57 Les neuroptéridées des bassins Houillers Belges (Première partie) Par F Stockmans Pp 62+16 plates Mémoire No 58 The Freeliving Marine Nemas of the Belgian Coast 2 with General Remarks on the Structure and the System of Nemas By L A De Coninck and J H Schuurmans Stekhoven Jr Pp 163 (Bruxelles)

University of California Publications in American Archaeology and Ethnology Vol 35 Nos 1 and 2 Yurok Marriages by T T Waterman and A L Kroeber Yurok and neighbouring Kin Term Systems by A L Kroeber Pp 62 (Berkeley, Calif University of California Press London Cambridge University Press) 25 cents

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CATALOGUES

The Beck Projectograph Pp 12. (London R. and J Beck, Ltd)

New and Secondhand Books on History throughout the Ages (Catalogue No 572) Pp 80 (London Francis Edwards Ltd)

A Dangerous Temperature Pp 4 Keep it Running Pp 4. (London Sternol Ltd.)

Scientific Apparatus Laboratory Equipment and Apparatus for Mensuration, Mechanics Sound, Heat, Light, Electricity Microscopy Technical Testing Chemistry, New and Improved Apparatus in the Microid Physical Series Griffex A R Chemicals, Technical Books, (Catalogue No 50L) Pp viii+864 (London Griffin and Tatlock, Ltd)